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Proceedings of the Forty-Second Annual Meeting of the American Association of Economic Entomologists Section of Plant Quarantine and Inspection

Monday Morning Session, December 30, 1929

The first session of the Section of Plant Quarantine and Inspection of the Forty-second Annual Meeting of the American Association of Economic Entomologists, held at the Hotel Savery, Des Moines, December 30, 1929 to January 1, 1930, was called to order at nine-fifty o'clock, Mr. Frank N. Wallace, Chairman of the Section, presiding.

CHAIRMAN WALLACE: Please come to order. The first business on our program is the appointment of committees.

Nominating Committee: R. W. Harned, L. S. McLaine and P. A. Glenn.

Resolutions Committee: G. A. Dean, K. C. Sullivan and A. C. Fleury.

I am going to ask Mr. McLaine to take the chair.

Mr. L. S. McLaine took the chair.

CHAIRMAN MCLAINE: The next item on the program is the address by the Chairman of the Section, Mr. Wallace.

SOME FUNDAMENTAL QUALIFICATIONS FOR REGULATORY EMPLOYEES

By FRANK N. WALLACE, *Indianapolis, Ind.*

ABSTRACT

The important qualifications are an adaptable, pleasing personality, patience and perservance, supplemented by good judgment, and agricultural background and general college training.

It seems to me that we are passing through a transition period in regulatory work. The general public is not yet convinced of the necessity or the legality of some of our acts. However, they do believe in our sincerity of purpose and are willing to accept our word for the necessity of some of the things we do.

It is generally recognized that a law inefficiently enforced soon loses the respect of the people and becomes a dead letter. I have a firm belief in the need of quarantine laws but do not believe that these laws, enforced by inefficient or surly employees, will continue to have the respect of the people, even if they are just and needed.

We have travelled fast in the past ten years and sometimes we have been on thin ice. The public has been breathless at some of our stunts. In the near future we will have to improve in our technique or stay a little closer to the shore; perhaps do both. My opinion is that we must acquire better men and adopt saner methods in the next decade than we have in the past.

We cannot afford to make mistakes just now with this growing doubt in the minds of some of our citizens as to the legality or necessity of some of our actions.

Wherever we met with antagonism in any of our lines of work in Indiana, I made an effort to analyse the situations in hopes of preventing future trouble.

In almost every instance where we have had difficulties it seemed to me that if the situation had been diplomatically handled from its inception we would have not had any trouble. It helps to have a few efficient men as leaders but I believe we need and must have all of our employees well trained and with an abundance of horse sense.

I have taken up this subject because one entomologist, whom I regard very highly, recently made this statement about a man in our employ. "He is too good a man for regulatory work." It is possible that others feel that way about regulatory work and I would like to know how general this feeling is held throughout the country.

In other meetings we have listened to some excellent addresses on the training and educational requirements of entomologists. I have always agreed that the principles laid down were fundamental and sound for men in research work. However, I have doubted if that training was all that was necessary for a man in regulatory work. *Can* applicants for regulatory positions be judged by their entomological training alone?

I think that there are many qualities necessary for a man to possess for him to be a success along this peculiar line of work. I am going to give you my own ideas on this subject, hoping that others, better qualified than I, will set up a standard whereby applicants can be judged. It has always been my belief that when the right man was put on the job, that job was half completed. If those of us who are responsible for a department such as we have in Indiana can find the men qualified for

the work, then our part will only be to determine our policies and see that the proper laws are passed and that sufficient money is appropriated for the needs of our departments.

I will now give you what I consider the specifications for an ideal regulatory entomologist.

To me the most important qualification is an adaptable, pleasing personality. A regulatory man meets several thousand people in a year. He meets young and old, rich and poor, educated and illiterate. All of them are citizens and are entitled to his services. He must meet them on an equal basis and must win their confidence, even though he requires them to do things which they believe unnecessary or inconsequential. He cannot do this without a pleasing personality.

He must have patience and lots of it. Job with all of his boils is a poor object lesson when you consider a regulatory man on corn borer control work.

He must have perseverence. It is discouraging to work for five years in one community trying to persuade farmers to cut corn six inches lower than is customary. Possibly it is irritating to try to convince a berry grower that it is necessary to rogue out mosaic-infected plants.

He should have a fundamental knowledge of the rights of the public and a keen discrimination between liberty and license. He must realize that he is vested with very broad authority but that authority should be used with discrimination. This, however, could be acquired by a careful study of the principles of quarantines as written by Dr. W. A. McCubbin. I consider this a most remarkable presentation and we as regulatory men will never go very far wrong if we follow out the principles laid down by him.

He should have some business judgment, a sense of proper proportions between costs and possible benefits to be derived from his recommendations.

He should have had specific training. This includes more than the accepted entomologist's training. I consider the necessary training to commence during the boyhood days.

If during his boyhood days he had lived on a farm it would give him an understanding of farm problems that would be difficult to acquire in any other way. Working on a farm during summer vacations would help him make up this deficiency if the boy had been raised in a city.

If he had taken a scientific course in High School this would help.

Then, when he entered college start in on a modified agricultural course. In giving my ideas about these four years I expect to be told

it is not practical and that it cannot be done. However, I am thinking in terms of regulatory work and not college curriculum.

Spend twelve hours in English; twenty hours in Chemistry; six hours in Physics; six hours in Geology; three hours in Public Speaking.

Give him all of the theoretical agricultural subjects; crops, three hours; soils, three hours; floriculture, six hours; forestry, six hours; olericulture, three hours; horticulture, fifteen hours.

Then give him all the biology possible.

In determining an applicant's fitness for a particular job it would be impossible to determine all of these points in an interview of an hour or so. Could not the college teachers in the early years of contact with the students more easily and correctly detect these attributes? Detection and development of these peculiar traits along with the necessary scientific training would give us the ideal regulatory man. However, there are some other phases that must be considered before we can expect students to take special training for our work.

Certainly an applicant for a position who expected to follow regulatory work must be assured of the stability of the position. Certainly he should not fear that a change in an administration would throw him out of office. Heretofore, in many States this has happened. He must be assured that this will not happen in the future. When the public becomes accustomed to the proper type of man for these positions it will be improbable that the politicians could ever hope to furnish the man with the necessary qualifications. As to the future of the man in regulatory work, assurance must be given that adequate reward will be offered for the man who selects this field.

In Indiana we are gradually increasing the maximum paid to our assistants. Fifteen years ago our law set $1,500.00 as the upper limit for deputies. There has been a gradual increase until last year the maximum was raised to $3,200.00. It is not high enough but we are now asking and hope to be able to increase the maximum to $4,000.00.

However, I believe that the man who takes up regulatory work and is interested in being adapted to it receives more than the mere salary paid. He meets interesting, stimulating people in all branches of Horticulture and Floriculture and if so inclined can make close friends with the best known men in these fields.

CHAIRMAN MCLAINE: Ladies and Gentlemen: The paper that we have just listened to is one that will cause all of us, especially those engaged in regulatory work, a great deal of thought, and I am sure that it should stimulate a great deal of discussion this morning. In

addition to those who are regulatory men, we also have teachers whom I feel would like to take part in the discussion.

MR. L. A. STRONG: I rather hesitate to lead a discussion on this paper, but I think the type of man Mr. Wallace has described would perhaps fit in better with some of our regulatory work than some of the men who have been engaged in such work. Regulatory work in this country is comparatively new, and must be so recognized.

The statement that a man on a particular piece of work is too good a man for regulatory activities is one with which I can't sympathize because, to me, regulatory work is of extreme importance. It may be that a man finds himself at some particular time on a particular piece of work which is not overtaxing his capacity, and he may be capable of doing a better piece of work than he is doing at that particular moment. If so, there is no difficulty at all in finding a place in regulatory work where all of his abilities may be used.

I want to say if we can find the type of men Mr. Wallace has described, I will undertake to see to it that they are placed in positions where they will have a full opportunity to exercise all of their ability. I think Mr. Wallace has opened up a field for discussion here which is well worth the consideration of this audience and of all people who are interested in regulatory work, and I sincerely hope there will be a good deal of discussion on it.

MR. C. H. HADLEY: While listening to Mr. Wallace's discussion of his ideal regulatory man, I was running over in my mind at the same time those men whom I have considered to be pretty good regulatory men and I am rather pleased to discover that most of the men I was thinking of at the time meet Mr. Wallace's general specifications.

There is one requirement I think I would perhaps emphasize a little more than Mr. Wallace has, and that is decided interest in that field of work on the part of the man in question. I have heard the same statement as Mr. Wallace referred to, that such-and-such a man is altogether too good a man to waste on patrol work and quarantine work. In some cases I admit that I would agree with the speaker, except that I wouldn't say "too good a man to waste," but I sometimes think it is unfortunate to saddle such a man on regulatory work;—not that the man was not a good man in many respects but that he didn't have primary interest in regulatory work.

DR. G. M. BENTLEY: The remarks very tersely made by Mr. Strong I thought covered the subject very well.

There were one or two things in Mr. Wallace's address. He mentioned six hours of floriculture. It seems to me if we are going to specify the different subjects, I think the subject of apiculture should be included for training in the classroom. I also think bacteriology in connection with apiary inspection is a very important one. I think the other things are all right, perhaps. I was greatly impressed by that three hours of public speaking. That is very important.

I will say in regard to the agricultural work, especially training in horticulture, and things like that, that courses along such lines are extremely important it seems to me for these men. From the little experience I have had, we strongly emphasize that, and we will not let any man go in the field who has not had a good fundamental training in agriculture.

The matter of contact and approach, I think, is important and cannot be emphasized too greatly. Many of these troubles that we hear about as we attend nursery and horticultural conventions emanate from lack of contact and lack of approach of these men in the quarantine service.

MR. A. C. FLEURY: There is one point I am not sure has been stressed that occurred to me as an exceedingly important acquisition for a satisfactory quarantine enforcement officer, and that is temperament. I believe a man has to be temperamentally fit or he is not going to make a satisfactory quarantine man, and that is something that probably he cannot secure through schooling.

The last gentleman who spoke mentioned approach, and I quite agree with him. I believe in the majority of instances objection to compliance with quarantine requirements on the part of individuals can largely be offset through a satisfactory approach. The quarantine man has to be a good salesman. He has to sell his idea to the party that he is doing business with. He is not dealing with a criminal; he is dealing with the average good citizen who may be unknowingly or unwittingly doing something that is not for the good of agriculture and which may be contrary to some law. That man must be approached not as a criminal but as a good citizen, and he must be sold to the idea of quarantine.

CHAIRMAN MCLAINE: Thank you, Mr. Fleury. We have with us one who has felt the effects of quarantine, and who has also been engaged in quarantine enforcement in connection with this serious and great menace in Florida, the Mediterranean fruit fly. I am going to ask Mr. Hume if he will be kind enough to say something as to the reaction of the public in regard to quarantine because he has had experience on both sides. Mr. Hume of Florida.

MR. HUME: I must very thoroughly agree with the last speaker. The question of temperament enters very largely into the success of any quarantine regulatory measures. The man who goes out on the firing line of regulatory work must, in the first place, have absolute control of himself. Some of us are prone to resent the statement that may be made. The man who is on the front line has to take everything that comes, and take it with a smile. If he can't hold his temper and hold himself absolutely under control that is no place for him.

There is another human element that enters into it, an element in life that has bothered me very much all the way through, and that is the determination to get the other man's viewpoint because you cannot deal with him unless you can see the thing from his angle, and that is an extremely difficult thing to do.

In any manner of regulatory work, we can go no further than the people will go with us. The distance they will go with us is determined by the knowledge they have of the situation, the necessity for it, and their understanding of it. The man who approaches the individual on a quarantine line is the one who may establish that individual's attitude toward the whole work. How far reaching that person's attitude may be to the whole work, nobody can determine. You do not know who you are dealing with. You do not know how far reaching their influence may be, and whether king or pauper they must all be treated alike, courteously, firmly, knowingly.

Those are the things which, to my mind, have more to do with the proper handling of regulatory work than almost anything else; knowledge, yes, but it is the human side of it you have to give attention to.

CHAIRMAN MCLAINE: Before we close the discussion, the members may be interested to know that Canada has taken an interest in regulatory work for a number of years, and that her Act in regard to the important pests and diseases was based on the Plant Quarantine Act of the United States. I am going to ask Mr. Gibson, the Dominion entomologist, to say a few words.

MR. ARTHUR GIBSON: I think what Mr. Hume has stated, that the human side enters very much into the importance of the quarantine outfit. Mr. McLaine can speak on this better than I can. He is the man in our service who has charge of our quarantine regulations.

MR. F. E. WHITEHEAD: I certainly agree with the speaker that it would be very desirable to give all the work that was suggested, and I am going to raise a question rather than try to answer it. If, at the beginning of the freshman year, a student had definitely decided to go

into regulatory work I think it would work out very nicely. While I did not count the hours, I think if the student was given everything suggested this work would be required from start to finish.

In the two or three schools I have been connected with, they have made an attempt to get away from requiring so much work. They give a student a chance to elect a considerable amount.

While this other is desirable, I don't see the possibility of it. If anyone has any suggestion as to how to give all this work and still not give required work from beginning to finish, or how you could select the students or whether it is possible to get men to elect this from the very beginning, I should like to have it. I didn't become interested in entomology until I reached my senior year. It would take four additional years after my senior year to prepare for this work. I wonder if anybody has any suggestions as to how to get around this difficulty.

MR. FRANK N. WALLACE: May I say that I got interested in this idea of getting men in the colleges to take it up because in regulatory work we were particularly interested in the men that came from one institution. They were all good men. They meet the public. They were interested in their work and we wondered why those men all happened to come from one institution. We found out afterwards that it was due to one man's efforts in picking those men.

I believe a man like that could pick out a man; I believe he could find them in the first year they entered college and decide they would be ideal regulatory men. I would hate to see a man decide himself that he would be a regulatory man, take four years of it, come out and be an absolute failure at it because there are some things he cannot acquire. I don't believe if he worked conscientiously all his life he could ever be a regulatory man if he didn't have some fundamental requirements. Certainly, we wouldn't want all the colleges to start turning out regulatory men, but let a few of them see if they can turn them out.

I know the positions will be open for them, but there was a time when the positions were not secure. I think that day is past. I think in most states we can definitely state that if a good man is in that position he can stay there. The heads of departments sometimes change, but a good man can stay right through.

CHAIRMAN MCLAINE: If there is no further discussion, I will turn the chair over to Mr. Wallace.

CHAIRMAN WALLACE: Next on the program is "Problems in Japanese Beetle Research," by L. B. Smith.

THE JAPANESE BEETLE IN 1929[1]

By LOREN B. SMITH, *Principal Entomologist, Division of Deciduous Fruit Insect Investigations, Bureau of Entomology, United States Department of Agriculture*

ABSTRACT

A summary of the present distribution, the feeding habits and injuries, life history, control measures and the results of parasite introductions.

Twelve years ago the first investigations were undertaken on the Japanese beetle (*Popillia japonica* Newman) and methods for its control. The purpose of this paper is to consider briefly the results which have accrued from this work as well as the present status of the insect.

The problems concerned with the control of the Japanese beetle are legion since it attacks a wide variety of plants and thereby affects not only the agriculturist and horticulturist but also the suburban dweller. Thus far the insect has been primarily a pest of fruits and ornamental plants, although during recent years it has shown a tendency to damage certain of our staple crops. The damage to crops has been serious only when the beetles have become very numerous. The injuries to economic plants have been local in occurrence even to the individual plants which are attacked, owing largely to the gregarious habits of the adult beetles. Hence there appears to be a great diversity of opinion among the growers and others in the generally infested area as to the economic status of the insect. There is no question that articles appearing in the metropolitan press concerning the damage by the Japanese beetle have led to great misconceptions in the minds of many as to its seriousness as a pest. It is true, nevertheless, that the Japanese beetle is an added burden to any community which offers favorable conditions for its development.

DISTRIBUTION OF THE JAPANESE BEETLE. The district of general infestation of the Japanese beetle now occupies an area 80 miles in diameter and approximately 5,000 square miles in extent in central New Jersey, Eastern Pennsylvania, and northern Delaware. The annual increase in the size of this area has been relatively slow and

[1]Contribution No. 72. Research Laboratories, United States Bureau of Entomology, Moorestown, New Jersey.

The writer wishes to acknowledge the contributions of the various investigators who have worked on this problem. Their untiring efforts in the face of many handicaps and the difficulties of the problems can be realized only by those closely associated with the work.

represents the natural spread of the insect. All infestations occurring beyond this represent colonies which have probably become established through the dissemination of the insect by some artificial means such as trains or motor vehicles. Its advance in a northward direction has apparently been retarded by the elevated hilly country in northern New Jersey. The beetle has extended its range northward to Washington crossing in New Jersey. It is still scarce along the New Jersey coast, although it has become well established in the pine-barren district in the central part of the state. West of the Delaware River the beetle has progressed with remarkable slowness. The extension of its range appears to be hampered by the presence of high ridges. In the valleys it has become exceedingly abundant, and in the suburban areas surrounding Philadelphia has caused severe damage to ornamental plants and shade trees.

The regions of densest infestation no longer coincide with the earliest infested area between Riverton and Moorestown, New Jersey. The density has moved outward, and there is a general reduction in the degree of infestation in the central part of the area.

Surveys of both the adults and larvae during the past several years indicate that the species is decreasing in the older infested area and is increasing rapidly in the more recently invaded territory.

Habits of Feeding and Injuries. The Japanese beetle is most conspicuous and injurious in the adult stage by reason of its active habits and the damage done to the foliage, flowers, and fruit of its food plants. The injury to foliage is comparable in appearance to the work of our native leaf chafers. The leaves are skeletonized and, when severely eaten, turn brown and drop, thus bringing about defoliation. Since the beetles prefer to feed on foliage exposed to the direct rays of the sun, it is not usual for them to defoliate entirely the larger trees and shrubs. The early ripening varieties of fruits are most subject to attack, and the beetles are fond of the green silk and developing ears of corn. They cluster on the tip of an ear, cut the silk off close to the husk, and feed on the developing kernels at the tip of the ear.

Nearly 300 species of plants have been recorded in the United States as furnishing food for the Japanese beetle. Among these are many of the economic crops grown in the infested territory. Between 25 and 30 species, however, are much preferred as food plants. The more important of these are apple, quince, peach, cherry, plum, grape, blackberry, clover, soy bean, and corn. The shade trees in the list of preferred food plants include linden, birch, white oak, elm, horse-chestnut,

willow, and sassafras, in addition to many shrubs and herbaceous ornamental plants. The most severe damage by the Japanese beetle now occurs in the Philadelphia suburbs, in Trenton and vicinity, and in Camden and Gloucester Counties, New Jersey.

The Japanese beetle larvae have thus far confined their damage mostly to lawns and golf courses. The injuries to the sod are comparable to those caused by the larvae of the small native May beetles of the genus *Ochrosidia*. As would be expected, the turf injury is much more severe and pronounced during periods of drought than it is when there is sufficient moisture in the soil to maintain the grass even when many of the roots have been destroyed by the grubs.

Life History of the Insect. The Japanese beetle has one generation a year. The adults begin to emerge between the 10th and 15th of June and are present until the middle of October. The adult female beetles each lay between 40 and 50 eggs in the soil. These are deposited separately, three to five at a time, about 2 to 4 inches below the surface of the soil. The egg-laying period is usually four or five weeks in length. The larvae become full grown in about six weeks, at which time they reach a length of approximately 1 inch, and resemble the larvae of *Phyllophaga* in appearance. They usually feed about 1 or 2 inches below the surface, but as the soil temperature approaches 50 degrees Fahrenheit in the Autumn they descend to an average depth of approximately 7 inches and there they pass the winter. In the spring they again become active and, approaching the surface, feed for about a month or six weeks before transforming to pupae. The adults begin to appear between two and four weeks after pupation.

Control of the Adult Beetle. When the Japanese beetle first became numerous in New Jersey, attempts were made to protect fruit by the use of a spray consisting of 1½ pounds of powdered lead arsenate to 50 gallons of water. This proved to be inadequate to protect the plants. It was later found that by increasing the dosage of lead arsenate to 3 pounds, and adding 2 pounds of flour having a high gluten content, to each 50 gallons of water, much better results were obtained in the protection of apples. This spray could not be used on peaches without danger to the plants. It was found that lime, chalk, lead arsenate, and other white materials applied to the ripening fruits repelled the beetles for a short time, although the repellent effect of all the substances except lead arsenate disappeared within a short time. As yet no effective means of protecting raspberries, blackberries, early ripening peaches, and the blossoms of flowering plants has been devised,

since the beetles tend to avoid the sprayed foliage and cluster on a ripe fruit or on an opening flower bud.

During the course of the early experiments it was believed that the size of the particles of lead arsenate might determine the quantity of poison consumed by the beetles. A colloidal lead arsenate was prepared but this gave only a slight increase in the number of beetles killed. A material known as oleate-coated lead arsenate was developed about six years ago. This is a composition of paste lead arsenate and about 2 per cent lead oleate. This coated lead arsenate has been found extremely useful in the protection of ornamental plants and nonbearing fruit trees. The lead oleate serves as an excellent sticker and spreader, and one application made in June has remained effective for the following six or seven weeks. A green lead arsenate was evolved recently which is eaten readily by the Japanese beetle. This kills a large proportion of the insects coming to the sprayed foliage, although it does not afford the protection to the plants which is obtained by the use of the oleate-coated lead arsenate.

The habit of the beetles in congregating on plants in large numbers suggested that contact sprays would be useful as a means of control It was found that a neutral soy-bean-oil soap made a very effective contact spray. Later studies revealed that the insectidical value of a soap is directly dependent on the strength of the film formed by that particular soap, and it was finally discovered that one prepared from a coconut fatty acid had the highest toxicity of any of the common soaps. A small quantity of oleo-resin of pyrethrum is now added to the soap to increase the effectiveness of the spray. Several preparations of pyrethrum and soap are available commercially and are being used as contact sprays not only for the Japanese beetle but to some extent for the striped cucumber beetle (*Diabrotica vittata* Fabr.), the harlequin cabbage bug (*Murgantia histrionica* Hahn), and certain others which up to the prsent time have been difficult to control.

Several years ago chemotropic investigations revealed that geraniol, one of the higher alcohols, was extremely attractive to the Japanese beetle. Few, if any, other insects have been found to be attracted to any degree by this chemical and it is apparently a specific for this insect. In commerce it is commonly used as an ingredient in the cheaper perfumes. Geraniol has been utilized in several ways in the control of the beetle; these include combining it with poisoned baits, as a means of concentrating the beetles in a small area where they may be killed with contact sprays, or more often as a constituent of baits used in mechanical

traps. The Japanese beetle traps have come into wide use by residents in the suburban area around Philadelphia. In conjunction with spraying, the traps are useful in capturing large numbers of beetles. During the summer of 1929 500 traps were placed on a 15-acre estate in the heavily infested district near Roxborough, Pennsylvania. The record of collections in these traps during the period between July 9 and August 23 gives a total of 1,874½ pounds of adult beetles and represents approximately 10,000,000 individuals. Many types of beetle traps are now on the market, ranging in price from 10 cents upward. The traps have not yet become sufficiently effective to warrant their use on farms. In fact, the presence of large numbers of traps may attract many beetles which are not captured, with the result that the grub population in the soil, in the vicinity of the traps, is greatly increased over what it would have been had the traps not been used.

The combination of lead arsenate with a highly refined, cane-sugar syrup has been found useful as a spray on noneconomic plants. The beetles are strongly attracted to it and eat it readily. This preparation is probably one of the most effective lethal sprays yet devised for the Japanese beetle. On account of the tendency to injure foliage it is not recommended for use on economic plants.

CONTROL OF THE LARVAE. In our studies of the control of the larvae the problem has had to be considered from two viewpoints. The first was the treatment of soil about the roots of plants and nursery stock which contemplated the extermination of any infestation which might be present. The second was the treatment of turf on lawns and golf courses. In a paper to be presented at this session, Doctor Fleming and Mr. Baker discuss the nursery treatments.

A 70 per cent emulsion of carbon disulphide, diluted at the rate of 1 quart to 50 gallons of water and applied to the turf, allowing 3 pints to each square foot of surface, has been found an effective means of destroying any grubs within the first 2 or 3 inches of soil. This is usually applied by means of a proportioner. This machine is so constructed that it can be attached to the hydrant, and as the water flows through the hose the desired quantity of emulsion is added to the water stream, the quantity added being regulated by a simple adjustment of a needle valve.

Several years of experimental work have shown that lead arsenate thoroughly mixed with the surface layer of soil will destroy most scarabaeid larvae and will not harmfully effect the growth of the grasses commonly used in golf greens and lawns. When a lawn is being made or a

golf green prepared, lead arsenate may be broadcast at the rate of 35 pounds to each 1,000 square feet of surface. The soil is then thoroughly disked to a depth of about 3 inches, graded, and planted. This treatment has been found to remain effective for between 5 and 7 years. It is possible to treat lawns having turf with a top dressing composed of 5 pounds of lead arsenate mixed with about a bushel of screened top soil or other suitable carrier and this quantity applied to each 1,000 square feet of surface. The top dressing should be repeated once a year until three applications have been made.

PARASITE INTRODUCTION. Nine years of work has resulted in the establishment of five species of parasites from the Orient in the generally infested area. The first of these to be recovered after releasement in this country is a tachinid fly (*Centeter cinerea* Aldrich) which is parasitic on the adult Japanese beetle. This was collected in 1923 following the releasement of a few individuals in 1922. This colony now occupies an area of about 85 or 90 square miles. The percentage of parasitism, however, remains very low. This parasite has also been colonized at Bridgeport, Connecticut, and Harrisburg, Pennsylvania, as well as in four locations near Philadelphia. Two dexiid flies, *Prosena siberita* Fabricius and *Dexia ventralis* Aldrich, which are parasitic on the larvae of the Japanese beetle were found to be established in 1927 from releasements made during the three previous years. Both species are effective as parasites of Popillia in Japan. Dexia has three generations in Japan but thus far only two generations have developed in the United States. Two solitary wasps, *Tiphia popilliavora* Rohwer and *Tiphia vernalis* Rohwer, have been introduced from Japan and Korea and established in the United States. *Tiphia popilliavora* was sufficiently numerous in 1927 near Riverton, New Jersey, that it was possible to collect 1,100 females for use in establishing eleven subcolonies in New Jersey and Pennsylvania. Since that year 14,500 females have been collected from the parent colony and 145 subcolonies have been established. This species is undoubtedly the most promising which thus far has been introduced and established in the eastern Pennsylvania-New Jersey district.

Other factors of natural control should not be overlooked. In the heavily infested area there is no doubt but that birds, particularly the starling and crow, blackbird or purple grackle, are among the more important factors in the natural control of this insect at the present time. Pathogenic bacteria, fungi, protozoa, and nematodes all play a part, and an important part, in preventing much more serious losses by the Japanese beetle than have occurred thus far.

CONCLUSION. The Japanese beetle, as yet, does not occur in sufficient numbers outside of a 5,000-square-mile area in central New Jersey and eastern Pennsylvania to cause any economic losses. Sporadic colonies now occur as far north as Boston, Massachusetts, and as far south as Norfolk, Virginia. Whether the economic importance of the insect under these new environmental conditions will be greater or less than it is at present is problematical. Studies of the biology, physiology, and habits of the insect indicate that the short growing season in New England, the summer droughts of the Middle West, and the relatively mild winters with little snowfall in the South may tend to inhibit the extremely rapid multiplication of the beetle. At the present time the fruit growers in the heavily infested area are successfully protecting their crops by methods which have been developed. Much yet remains to be accomplished in the matter of devising better methods for protecting early ripening varieties of peaches, small fruits, corn, and plants in flower. The present methods of control for the larvae are satisfactory and if properly applied will entirely prevent turf injury. The natural factors of control, including the importation of foreign parasites, appear to be reducing the density of infestation in the areas longest occupied by the beetle, and it appears as though the future effectiveness of these elements of control will be even greater than it is now.

CHAIRMAN WALLACE: Is there any discussion of this paper?

MR. H. G. BUTLER: What experiments have been carried out as to the value of the insecticutor electric trap?

MR. SMITH: We have tested the electric insect trap known as the insecticutor, but we found it was not sufficiently powerful to destroy.

MR. GIBSON: I should like to know more about the spread this year.

MR. SMITH: Mr. Hadley has a paper following mine covering the distribution last year.

CHAIRMAN WALLACE: Next is "Treatment of Soil to Destroy the Japanese Beetle," by W. E. Fleming. Mr. Fleming is not here, but Mr. Smith will read his paper.

TREATMENT OF SOIL TO DESTROY THE JAPANESE BEETLE[1]

By WALTER E. FLEMING, *Entomologist* and FRANCIS E. BAKER, *Assistant Entomologist, Deciduous-Fruit Insect Investigations, Bureau of Entomology, United States Department of Agriculture*

ABSTRACT

This paper summarizes briefly the different methods of treating soil to destroy the Japanese beetle, *Popillia japonica* Newman, which are now in use in commercial nurseries within the infested area.

The Japanese beetle, *Popillia japonica* Newman, a recognized agricultural pest, was probably introduced into the United States in an immature stage in soil about the roots of nursery plants. It is now dispersed over a limited area on the Atlantic seaboard and is gradually spreading naturally to adjacent uninfested territory. In order to prevent its artificial dissemination with nursery products, the shipment of plants with soil about their roots to points outside the infested area is forbidden by law unless such plants are free of all living stages of the insect. Since there are approximately 5,000 dealers in nursery stock within this infested area, many of whom are doing a national and an international business, it is important that methods for handling and treating the various types of stock be developed.

In view of the fact that the immature stages are found in the soil at all seasons of the year, experiments have been conducted continuously during the past eight years to develop practical methods for preventing and destroying infestation in the various nursery products. During the course of this work it has been found necessary to evolve methods for destroying the immature stages in potting soil, soil plots, cold frames, and greenhouse benches, as well as in the soil about the roots of established plants. This paper summarizes briefly the different procedures which are now in use in the commercial nurseries for treating and handling soil under various conditions.

TREATMENT OF POTTING SOIL. Soil which is to be used for growing potted plants can be treated by heating it with live steam or by fumigating it with carbon disulphide or naphthalene. Soil of any type can be treated, provided it is dry or moist and friable.

In applying the steam treatment, steam under 70 pounds' pressure is dispersed through the soil. The soil is heated throughout to a temperature of 130°F. and maintained at this temperature for a period of 30 minutes.

[1]Contribution No. 69 of the Japanese Beetle Laboratory, Bureau of Entomology, Moorestown, New Jersey.

Fumigation with carbon disulphide is carried on in a gas-proof box or bin, by injecting carbon disulphide, of technical grade, at the rate of 1 pound to each cubic yard of soil. Any quantity of soil may be fumigated, provided the carbon disulphide is distributed uniformly throughout the mass. One method is to treat each 18-inch layer of soil separately as the container is being filled. The first 18-inch layer is treated by injecting carbon disulphide at the rate of ½ pound, or 176 cubic centimeters, to each square yard of surface, distributing the material evenly in holes 2 inches deep and 18 inches apart. When the first layer has been treated, a second 18-inch layer may be placed in the container and treated in the same manner. This process may be repeated until the container is filled.

Another method for applying carbon disulphide is to treat the soil after the box or bin has been filled. This is done by making holes from the surface to different levels so that the material is applied in the same positions as by the first method. The liquid in this case should be poured into the deeper holes through a tube to insure that it reaches the proper level before coming in contact with the soil. The box or bin is sealed immediately after the carbon disulphide is applied, and is left undisturbed for at least 48 hours.

The effectiveness of the treatment with carbon disulphide depends to a large extent upon the temperature of the soil. The higher the temperature the more quickly the material volatilizes, the more readily the vapor diffuses through the soil, and the more easily the insect is killed. The temperature should be at least 45°F. when the treatment is applied, and it should not fall below 40°F. during the course of the treatment.

The naphthalene treatment is applied by mixing 5 pounds of flake naphthalene, free from tar, with each cubic yard of soil. The success of the treatment depends to a large extent on the thoroughness with which the flakes are dispersed throughout the soil. The treated soil is stored at a temperature of at least 50°F. and left undisturbed for at least one week.

It is desirable that fumigated soils be aërated before they are used. After potting soil has been treated by any of the preceding methods, it is necessary that it be stored and handled in such a manner as to prevent reinfestation.

Treatment of Soil in Plots, Cold Frames, and Hotbeds. Soil in plots, cold frames, and hotbeds which is used for plunging pots or heeling-in plants can be treated by fumigating with carbon disulphide,

carbon disulphide emulsion, or naphthalene, or by poisoning it with lead arsenate. Fumigation will destroy the infestation present, but will not prevent subsequent reinfestation. Poisoning with lead arsenate, on the other hand, may afford protection for more than one season.

The carbon disulphide treatment is applied to moist or dry soils by injecting the material at the rate of 6 pounds to each 100 square feet of soil surface. It is poured into holes 12 inches apart and 1 to 2 inches deep, 21 cubic centimeters of the liquid being used in each hole. The holes are filled with soil immediately after the liquid is applied and the entire treated area covered with a tarpaulin or other suitable material. The temperature of the soil 6 inches below the surface should be at least 45°F. when the treatment is applied, and it is necessary that the temperature remain above 40°F. for the subsequent 48 hours.

The carbon disulphide may also be applied in the form of a dilute emulsion. It is emulsified with a suitable material such as a castor oil soap and diluted with water so that there are 90 parts of the carbon disulphide to 100,000 parts by volume of water. Two and a half gallons of the dilute emulsion are applied to each square foot of soil surface, galvanized iron strips being sunk to a depth of 3 inches to confine the liquid to the area to be treated.

The naphthalene treatment is applied by spreading 46 pounds of flake naphthalene over 1,000 square feet of surface and cultivating until the material is thoroughly mixed with the upper 3 inches of soil. The land is then left undisturbed for at least one week before using it for plants.

The preceding fumigation treatments should be applied after the adult beetles have disappeared, except in those cases where screens or other suitable barriers prevent the adults from coming in contact with the soil. Precautions should be taken also to prevent the migration of larvae from adjacent untreated soil into the treated area. This may be accomplished by treating an additional band at least 3 feet in width or by having suitable obstructions, such as tight wooden frames or concrete walls, around the plots.

Powdered lead arsenate is applied in the same manner as naphthalene to the soil. It is used at the rate of 35 pounds to 1,000 square feet of soil surface. As this material is a stomach poison which has to be eaten by the larvae, it may take several weeks before the larvae have consumed a lethal dosage. The effectiveness of the treatment is dependent upon having the poison in the soil when the eggs are hatching and upon the thoroughness with which it is mixed with the upper 3 inches.

TREATMENT OF POTTED GREENHOUSE PLANTS. There is no method at the present time of treating potted greenhouse plants that can be applied without causing serious injury to the plants. The infestation may be removed from some varieties by washing all soil from the roots, and repotting the plants with beetle-free soil, but this procedure is not recommended for general practice. The nurseryman who desires to ship potted plants outside the known infested area should take every precaution to have both soil and plants free of infestation at the time of potting ,and to grow the plants in frames or houses so protected as to prevent the beetles from getting into the pots.

TREATMENT OF HARDY, HERBACEOUS PLANTS. The soil about the roots of hardy, herbaceous plants, which are grown in the field, can be treated during the dormant season. These plants may be divided into three groups according to the methods of treatment.

The first group of plants can be safely freed of infestation only by washing all soil from their roots. The washing may be done by directing a stream of water under slight pressure on the roots or by shaking the roots in a tub of water until all the soil is removed. Among the species which may be treated by this method are *Arenaria* spp., *Calimeris* sp., *Centaurea* spp., *Chelone* spp., *Chrysanthemum* spp., *Delphinium* spp., *Digitalis* spp., *Festuca* spp., *Gaillardia* spp., *Gypsophila* spp., *Hibiscus* spp., *Hypericum* spp., and *Valeriana* spp.

The second group of herbaceous plants can be treated successfully either by washing the soil from the roots, as in the previous group, or by immersing the roots in hot water. Among the species which may be treated by these procedures are the following: *Allium* spp., *Astilbe* spp., *Baptisia* spp., *Coreopsis* spp., *Dahlia* spp., *Filipendula* spp., *Lythrum* spp., *Pentstemon* spp., *Phlox* spp., *Polygonum* spp., *Sedum* spp., and *Thalictrum* spp.

Herbaceous plants are usually most resistant to hot-water treatment when they are dormant and most susceptible when they are growing vigorously. It is, therefore, recommended that this treatment be applied only when the plants are dormant or semidormant. In preparing the plants for treatment excess soil is removed, and the roots are pruned and large clumps divided as much as possible without causing injury. Small plants, bulbs, and root stocks may be treated in bulk in wire baskets, but large plants are usually handled individually. The roots are immersed completely in water held at a constant temperature of 112°F. After the soil about the roots is heated throughout to the temperature of the bath, the plants are kept in the water for a period of 70

minutes. The plants then should be cooled slowly to room temperature and dried before being packed for storage or shipment, or before being planted in soil.

The third group of perennial plants can be treated by washing the soil from their roots, by immersion in hot water, or by immersion in dilute carbon-disulphide emulsion. Among these varieties are *Hemerocallis* spp., *Iris* spp., *Paeonia* spp., and *Rheum* spp.

In preparing the plants for immersion in dilute carbon-disulphide emulsion, the same procedure should be followed as that used in preparing plants for treatment with hot water. The roots are immersed in a dilute emulsion, containing 60 parts of carbon disulphide to 100,000 parts of water, and held in this solution at a temperature of 70°F. for a period of 24 hours. It is necessary to maintain the temperature at approximately 70°F., because if the temperature falls below 65°F. the immature stages of the beetle may not be killed and if it rises above 75°F. the plants may be injured. The treatment is effective in killing the stages of the beetle in loose, friable masses of soil when the diameter of the mass is not greater than 6 inches. It may not be effective when the soil ball is wet, compact, or greater than 6 inches in diameter. The dilute emulsion is the least injurious to plants when they are dormant or semidormant. It is recommended, therefore, that the treatment be applied only during the dormant period. After the period of immersion is completed, the plants should be removed and handled in a manner similar to that used in handling plants treated with hot water.

Treatment of Small Fruits. The only small fruit which it has been necessary to treat is the cultivated blueberry, *Vaccinium* spp. The soil about the roots of the cultivated blueberry can be treated while dormant or semidormant by immersion in hot water and handling in the same manner as the roots of herbaceous plants.

Treatment of Deciduous Ornamental Shrubs. The soil about the roots of deciduous shrubs can be treated safely only when the plants are dormant. In this condition they can be treated by washing all soil from the roots, by dipping in dilute carbon-disulphide emulsion, using the same procedure as that employed in the treatment of herbaceous plants, and by treating with dilute carbon-disulphide emulsion in the field before digging. The varieties of shrubs which may be treated include the following: *Berberis* spp., *Buddleia* spp., *Cornus* spp., *Deutzia* spp., *Euonymus* spp., *Forsythia* spp., *Hydrangea* spp., *Ligustrum* spp., *Lonicera* spp., *Philadelphus* spp., *Spiraea* spp., and *Weigela* spp.

In applying the carbon-disulphide emulsion to a shrub in the field, the weeds and debris are removed from the surface of the soil about

the plant. The soil is then leveled. After the size of the mass of soil which is to be lifted is determined, a galvanized-iron collar, at least 6 inches greater in diameter than the proposed ball, is placed about the plant and forced to a depth of 3 inches into the soil. The soil is firmed carefully on each side of the metal collar, thus forming a basin about the base of the shrub. The dilute emulsion is then prepared. The dilution of carbon disulphide necessary depends upon the temperature of the soil. When the minimum soil temperature 6 inches below the ground is between 40° and 50°F., 90 parts of emulsified carbon disulphide are mixed with 100,000 parts of water. When the temperature is from 50° to 60°F., 75 parts to 100,000 are used, and when the temperature is from 60° to 70°F., 60 parts are used. In order to avoid serious injury to the shrubs, the concentration should not be greater than necessary. The dilute emulsion is poured into the basin about the shrub, 2.5 gallons being applied to each square foot of surface, and allowed to soak into the ground. Forty-eight hours after the solution is applied, the plant may be dug and handled according to the usual nursery practice, except that no untreated soil from outside the collar should be lifted with it. It should be dug between 2 and 5 days after treatment to prevent reinfestation.

In view of the fact that this treatment is applied in the field where temperature, moisture, texture, drainage, and other soil factors are usually beyond control, it is necessary that the treatment be limited to those conditions which are conducive to effective insecticidal action. The minimum soil temperature 6 inches below the surface should be at least 40°F. for the 48-hour period immediately after application of the emulsion. The surface of the soil about the base of the shrub should be level, and treatment should not be applied where the ground has a slope of more than 1 inch in 10 inches. The treatment should not be applied to ground having a hard-pan of clay, a rock formation, or high-water table near the surface which will inhibit the proper penetration of the solution. It also should not be applied to newly-transplanted shrubs or to artifically prepared beds where the penetration is uneven and rapid. As a general guide it has been found that a satisfactory treatment is usually made when the solution disappears from the surface uniformly in less than 5 hours and when its disappearance requires more than 10 minutes.

Treatment of Deciduous Ornamental Trees. Deciduous ornamental trees can usually be treated successfully while dormant or semi-dormant by the methods used on deciduous ornamental shrubs. In-

cluded in this class of plants are the following: *Acer*, spp., *Aesculus* spp., *Betula* spp., *Catalpa* spp., *Fagus* spp., *Magnolia* spp., *Quercus* spp., *Salix* spp., *Sorbus* spp., and *Ulmus* spp.

TREATMENT OF BROAD-LEAVED EVERGREENS. The soil about the roots of broad-leaved evergreens, which are usually dug with a soil ball, can be treated only by applying carbon-disulphide emulsion in the field before digging. This should be done in early spring or in the fall when the plants are in a semidormant condition. Included in this class of plants are *Abelia* spp., *Azalea* spp., *Buxus* spp., *Cotoneaster* spp., *Ilex* spp., *Kalmia* spp., *Pachysandra* spp., *Pyracantha* spp., and *Rhododendron* spp.

TREATMENT OF NARROW-LEAVED EVERGREENS. The procedure used in treating broad-leaved evergreens can be used in treating narrow-leaved evergreens, such as *Abies* spp., *Juniperus* spp., *Picea* spp., *Retinospora* (*Chamaecyparis*) spp., *Taxus* spp., *Thuja* spp., and *Tsuga* sp.

The treatment of the soil of the various nursery products interferes, to some extent, with the normal routine of the nursery and increases the cost of production, but it has enabled many nurserymen to maintain some of their business outside of the area known to be infested with the Japanese beetle. A large part of the experimentation to develop the various treatments was carried on under emergency conditions in cooperation with the nurserymen concerned. The treatments are not entirely satisfactory because of certain necessary requirements which are sometimes difficult to meet in the nursery, and because their application is limited to specific varieties during the dormant or semidormant season. Experimentation is still under way to develop simpler and better methods for handling the various types of nursery products, so that they can be shipped outside the infested area.

CHAIRMAN WALLACE: Are there any questions? If not, the next is by C. H. Hadley.

A SUMMARY OF QUARANTINE AND CONTROL OPERATIONS

By C. H. HADLEY, *Camden, N. J.*

(Withdrawn from publication)

CHAIRMAN WALLACE: Is there any discussion? Are there any questions you wish to ask Mr. Hadley?

We will take up "The Mediterranean Fruit Fly Eradication Campaign," and Mr. Strong and Dr. Newell are going to handle that for us. I think Mr. Strong is going to say something first.

THE MEDITERRANEAN FRUIT FLY ERADICATION CAMPAIGN

By LEE A. STRONG, *Plant Quarantine and Control Administration, Washington, D. C.*

Any discussion by me at this time of the Mediterranean fruit fly situation will be under what seems to be a disadvantage. Circumstances beyond my control prevented my having any intimate contact with the fruit fly work prior to the first of this month. Lack of opportunity to investigate conditions on the ground, however, has not entirely discouraged expressions of opinion as to the work that is being conducted. Some of the most profound expressions of opinion and criticism of the Mediterranean fruit fly work reaching my desk have contained no reference to the writer having been on the ground to make an investigation, or to having had any experience with fruit fly work in any place.

I want to say that the Plant Quarantine and Control Administration has no objection whatsoever to any honest expression of opinion of the work that is being conducted on the Mediterranean fruit fly, or any other work of the Department, and any honest criticism of that work is welcome.

I do feel, however, that a work as important as this work is, dealing with a pest of the unquestioned importance of the Mediterranean fruit fly, merits a rather close investigation of all the facts before a widespread criticism is voiced.

It is significant that the people who have gone to Florida and who have investigated conditions have endorsed the work of the Plant Board of Florida and the United States Department of Agriculture. In my judgment, an investigation of conditions doesn't merely embrace considering what the fruit fly has done in other countries and reading in the newspapers that banks have failed, and attributing everything that is bad to the Mediterranean fruit fly campaign. It contemplates and should embrace an intensive investigation of all conditions in Florida, of the economic conditions in Florida, and not only what the fruit fly has contributed to the present economic condition but what other factors contributed to the economic condition which existed before the fruit fly was found in Florida.

I have had an opportunity during the past month to find out something about the fruit fly work, and I want to say that I don't believe a problem was ever attacked in this country in the same manner that the fruit fly problem has been attacked. The fruit fly represented the major problem in insect control and extermination when it was found in this country. We have heard for a number of years that the fruit fly once

found has never been eradicated. I don't know of any real, honest effort at extermination that has ever been made before.

When you consider the population of flies that was found in Florida, the district that was infested, the conditions which had to be met, the difficulties which had to be overcome in starting an eradication program on a pest of that kind, and when you consider that from the sixth of April the fly population was reduced until now there has not been a single live fly found in Florida since the twenty-seventh of August, with the exception of the orange found on the sixteenth of November infested with larvae, I will say that any criticism of the work that has been conducted is appropriate only after a full investigation of what has brought about that condition.

The attitude of the Plant Quarantine and Control Administration, the whole Department of Agriculture, the State Plant Board of Florida, and the citizens of Florida, has been that there is only one thing to be considered and that is the complete extermination of the fruit fly in the United States. Every movement that is being made is looking to that end.

Naturally that involves the cooperation of everybody who is interested in the eradication of fruit fly in this country, whether they reside in Florida or not. The condition which exists today, and I think it is a remarkable one and is a tribute to those who have been in charge of the work (and I can say that because I have had nothing to do with it at all until the first of this month), could not have been brought about if it hadn't been for the 100 per cent cooperation of the citizens of Florida. We have had objections from people down there, just as I would object or you would object if you had your crop destroyed or a part of your crop destroyed. The restrictions are burdensome, are bound to be, and for that reason because they are burdensome and because just as long as the fly exists in the United States burdensome restrictions will have to be maintained, it is unthinkable that any program could be considered but eradication—eradication and complete eradication as promptly as possible. That is the only answer to the burdensome restrictions which now exist.

We are meeting with some objection, and perfectly honest objection, on the part of some of the states outside of Florida to what they have considered has been a little bit too lenient an attitude perhaps on the part of the Department in permitting the movement of products out of Florida.

The research bureaus of the Department cooperating with the Florida people have made remarkable progress in the working out of methods for

the treatment of fruits, and in the poison baits to reduce the population of the fly.

This is my personal observation in Florida. The quarantine enforcement around the eradication area is, in my judgment, as fine a piece of quarantine work as I have ever seen. I wish Mr. Wallace could go down there and see these men picked up without any previous training in quarantine work, and who under certain methods of discipline have developed into a fine set of quarantine officers.

All those things, plus the fact that no fruit is being moved at all which is under suspicion of being infested, lead us to believe that we are taking those precautions which are adequate to prevent the spread of the fruit fly to the other states.

Now, then, we are assuming an obligation in the United States Department of Agriculture when we permit the movement outside of Florida of these fruits. We assume the responsibility for 100 per cent treatment of that fruit. We say that the treatment is effective 100 per cent in killing any Mediterranean fruit fly which may be present in every stage. We have to say that or else we are not justified in allowing that fruit to move. We have to guarantee that our supervision is 100 per cent, otherwise the states would not be justified in accepting the fruit.

I believe if the quarantine officers of the various states in which this fruit is going would go to Florida, look into conditions there, observe the packing house requirements, packing house supervision, the grove inspection which, by the way, is not built up to the point which we would like to have it and which we expect to have; if they would look over the enforcement of the quarantine at the eradication line, I believe they would feel a great deal more comfortable in accepting this fruit in their state.

We have, on the other hand, objections from the citizens of Florida who feel our restrictions are too drastic. The fact that with but one exception no fly has been found, since the twenty-seventh of August, has led to a more or less general belief among the people not fully informed that the fly has been completely exterminated. I don't believe it has. I think we are going to find more flies in Florida, but I am very hopeful that we will find them in such places and in such limited numbers that our force will be adequate to immediately stamp them out.

We have reached a point in decreasing the population of the fly where the only thing that can be thought of is eradication. We must eradicate the fly. If we let it spread to other states our task is not nearly

so easy. It is far easier if we can keep the fly confined to the present locality of known infestation and stamp it out. If we are not able in this country, after building up our quarantine restrictions over a period of years, to cope with just such a situation as this—and if after all these years of enforcing restrictions, and after all the results that have been accomplished we are going to let this fruit fly get away from us, I say it is a pretty serious indictment of the regulatory workers of this country. I believe every entomologist and every citizen believes in the work, in the protection of agriculture, and realizes the necessity for the eradication of the pest; they not only recognize this need, but will be back of it.

I am not in a position to discuss the details of the work. Dr. Newell is here. He has been on the line every minute since the fly was found in Florida, and I am going to let him say whatever is said about the details of the work. (Applause)

CHAIRMAN WALLACE: Dr. Newell. We will wait for any discussion until we have heard from both of you.

THE MEDITERRANEAN FRUIT FLY SITUATION

By WILMON NEWELL, *Gainesville, Fla.*

Mr. Chairman, Members of the Association, and Visitors: I had a very severe shock this morning when I learned that Dr. Marlatt was not going to be here to appear on the program to discuss the fruit fly situation and I was advised that I would have to substitute for him. It would be a very difficult matter at any time for any member of this Association to attempt to substitute for so able a speaker as Dr. Marlatt, who not only possesses the ability to pack a great deal of very valuable information into a very short space of time but has the ability to present it with most charming grace. We are also handicapped by the fact that we do not have the slides which Dr. Marlatt had expected to use in illustrating his talk. I must, therefore, apologize in advance for a somewhat rambling discussion of this situation, using a very hastily assembled outline in the preparation of which Dr. J. H. Montgomery assisted me this morning.

I am glad Mr. Strong has discussed some of the general features of the fruit fly situation. All he has said is pertinent to the subject, and that leaves me free to confine myself almost entirely to some of the details.

Naturally, any discussion of this situation—which has developed since our last meeting—would open with a statement that the fruit fly,

for the first time in the history of North America, was discovered in this country on April 6, the point of discovery being Orlando, Florida, in the very central portion of the State and in the very heart of the great citrus and winter vegetable industries.

On April 9, C. T. Greene, of the United States National Museum, examining specimens in Washington sent from Orlando, identified them as the larvae of the Mediterranean fruit fly. The following day, April 10, adult specimens, captured in groves in Florida, were identified by C. T. Greene and J. M. Aldrich of the United States National Museum as *Ceratitis capitata* Wied., thus confirming the larval determination very quickly, and leaving absolutely no question as to the identity of the insect.

Between April 6 and 9, while specimens were enroute to Washington and in process of being examined, five trained inspectors were at Orlando attempting to delimit the infestation and determine its intensity. By the 10th, thirty more inspectors, formerly employed or in the employ at that time of the Plant Board of Florida, on other work, were on their way to Orlando. Immediately after this discovery Dr. C. L. Marlatt, accompanied by Dr. A. C. Baker, the head of the Tropical and Sub-Tropical Insect Investigations of the Bureau of Entomology, proceeded to Florida.

Most of you probably know that the Bureau of Entomology has maintained at Orlando for a number of years a well-equipped laboratory for the study of citrus insects and diseases. The services of this laboratory were, of course, immediately available with a considerable number of its regular force.

On April 15, nine days after the discovery of the fly, the State Plant Board met and promulgated quarantine regulations covering intra state movement of dangerous material. That State quarantine indirectly had the effect of shutting off the flow of dangerous material to other States some time in advance of its being possible for the federal Department to get its quarantine machinery in operation.

You probably know that in recent years there has developed from Florida into adjacent States a very large movement of citrus fruits by truck, called "bulk movement." Truckloads of fruit, usually of inferior grade, not packed in boxes, but loaded just as one would wheat, potatoes, or turnips, were transported over good roads to all parts of the South for retail sale. The State quarantine measures, placed in effect very quickly after the discovery of the fly, stopped that movement entirely. Very fine cooperation was secured from all of the local police officials.

County traffic officers, city police forces and others responded quickly to the appeal of the Plant Board to assist in enforcing that quarantine. Where there had been many hundreds of truck loads of fruit from the infested area moving to other States, this movement was cut down to practically none at all within a very few days.

At the same time, the Plant Board appealed to the Governor for permission to make use of the National Guard of Florida for enforcing the quarantine, and it was during the few days' interval between this request and the authorization on April 17 for calling out the National Guard that the local police officers and county officers did such excellent work. The action of the Board, of course, was to throw a quarantine around the area in which the fruit fly had been found, and that line was quickly manned by members of the Florida National Guard in uniform, acting as agents of the Plant Board. Shortly afterwards a special act of the Florida legislature was passed, authorizing use of the National Guard for the enforcement of the fruit fly quarantine. Of course, the members of the National Guard were as readily instructed in matters of enforcing quarantines and intercepting dangerous material as would be any other body of men similarly employed, and the fact that it was an organized body of men already under discipline made it possible to get the quarantine into effect very quickly.

On April 15, through joint action of the Governor and the State Plant Board, a $50,000 emergency fund was released from the State Treasury. On April 17, the Department in Washington made available $40,000 by transfer from the pink bollworm appropriation. By Public Resolution No. 1, 71st Congress, approved May 2, 1929, there was made available for combating the fruit fly $4,250,000 from an appropriation previously made for other purposes but which had not been expended.

On April 10, the Department transferred to Florida six trained fruit fly inspectors from the Rio Grande Valley where they had been engaged in work against the Mexican fruit worm. Ten pink bollworm scouts were, on April 12, transferred from Texas to Florida.

At the same time, the entire organization of the State Plant Board, numbering some sixty men, quite a large number of the Experiment Station staff and a number of extension workers, were drafted, so that very shortly there was an organization of upwards of 150 men at work.

As I have said before, the laboratories of the Bureau of Entomology and the Bureau of Plant Industry also had a number of men available. The Bureau also had two or three trained entomologists at its Sanford laboratory just a few miles north of Orlando, and they were made available also.

There followed immediately the recruiting of a force to deal with the situation, this, in a large measure, embracing past employees of the Department or the Florida Plant Board, men who had previously been engaged in citrus canker eradication or inspection work, or in certain lines of work which previously had been carried on by the Administration or the Bureau of Entomology. We have members on this Florida staff who have worked on the corn borer, Japanese beetle and gipsy moth projects, a pretty representative collection of men who have had experience in Federal and State activities of this character.

On April 28, the Plant Quarantine and Control Administration held its hearing in Washington on the question of placing a quarantine upon Florida and Florida host products. As a result, Quarantine No. 68, and the Rules and Regulations Supplemental Thereto, were promulgated, effective May 1. The work of the Plant Quarantine and Control Administration was quite readily divided into what might be termed three major projects in connection with the fruit fly campaign; first, "cleanup, quarantine enforcement and identification work in Florida;" second, "research work" conducted by the Administration in cooperation with the Bureaus of Entomology, Plant Industry, and Chemistry and Soils of the Department, and the Florida Experiment Station. Dr. A. C. Baker was placed in charge of this work and immediately took up his activities very vigorously at Orlando.

Another project, "Activities in the Southern and Western States," was placed in charge of P. A. Hoidale who had been for a considerable period in charge of the Mexican fruit fly work in the Rio Grande Valley.

I will not take time to discuss the quarantines in any detail. It is only necessary to tell you that the quarantines of the Plant Quarantine and Control Administration, Department of Agriculture, apply to interstate movements, whereas the quarantines promulgated by the State of Florida apply to intrastate movements and the enforcement of such regulations and measures within the State as are deemed necessary for the eradication and the carrying out of the purposes of the Federal regulations. The two, of course, parallel each other.

The interstate quarantines may be illustrated by the manner in which citrus fruits are permitted at this time to move interstate from the eradication area, and indeed from almost the entire State of Florida. Quarantine No. 68 naturally applies to the whole State as being the State in which infestation occurs, but the restrictions applied in the area where no infestation has been found are not quite as drastic and exacting as those applying to products produced within the area in which infestation has been found.

In the case of citrus fruits (such as oranges or grapefruit), shipped at the present time from any point in the eradication area, the groves or orchards are inspected to see whether there is any indication of fruit fly being present. In addition, the owner of the grove is required to pick up at weekly intervals all dropped fruit and windfalls and make safe disposition of them. Safe disposition in this case consists in burying them with lime and covering with not less than three feet of earth. In addition to that, he has been required to spray his grove with bait spray a number of times, usually three or four.

A permit is issued for the movement of the fruit from the grove to the fruit packing house. At the packing house, an inspector checks in every box of fruit, and verifies the fact that it has come from an inspected and certified grove. The packing house inspector also keeps track of the identity of all fruit arriving at that house to see that it goes only to destinations approved under the regulations. If the particular lot of fruit is to go to a part of the United States where sterilization is required, sterilization is performed by the management of the packing house checked by a representative of the Department. As a rule, temperature readings are made every three hours, or oftener where automatic recording devices are not installed, and the sterilizing inspector stays with the lot of fruit from the time it goes into the sterilizing chamber until it comes out, and must verify the maintenance of its identity until it is loaded into the car and billed out.

Following the checking of the sterilization in the packing house, permits are issued for the shipment of every carload of fruit, the inspector seeing that it goes to a permissible destination. The transit inspectors of the Department check these cars at the diversion points and again at destination. The fruit is watched from the time it is picked off the tree in the grove until it is finally delivered to the retail merchant.

The activities within the State under the State quarantine consist, of course, in preventing the movement of material from the eradication area to the rest of the State of Florida except under permit and proper safeguards.

I regret we have not at hand a large map of the State but from this small one, you will note that the eradication area is bounded on the south by a line passing through the southern edges of Polk and Osceola counties, on the east by the Atlantic Ocean, on the north by an irregular line beginning a little south of Jacksonville and extending across the State to the Gulf at or near Cedar Keys, and on the west by the Gulf of Mexico. You will readily see that spread overland cannot take place east or west, but only north and south.

In the area which I have tried to indicate and which is called the eradication area, there have been recorded 1,000 infested properties. That number, of course, includes city properties, and small back yards, as well as commercial plantings. These 1,000 infested properties were distributed through twenty counties. That area contains 10,000,000 acres, or between 15,000 and 16,000 square miles. In it is located 72 per cent of the bearing citrus trees of the State—orange and grapefruit—producing normally (6-year average) 73 per cent of the State's citrus crop. The citrus acreage in the area is about 120,000 acres, and of non-citrus host fruits and vegetables there are about 160,000 acres.

Fortunately, conditions of soil, terrain and topography in that section of Florida lend themselves to the enforcement of quarantines of this character. Because of sandy land in some places, swamps and dense hammocks in other parts, it was necessary to build the main highways following certain characters of the topography. Therefore, we do not have to contend with the possibility of prohibited or contraband material being hauled across the country anywhere and everywhere. If it is to be transported, it must follow the highways. Therefore, we have had a very great natural advantage in examining the traffic moving out of that area.

Up to December 31, 1929, on the northern and southern boundaries of the eradication area, 2,670,994 road vehicles had been inspected, of which 28,850 were found to contain host fruits or vegetables which were confiscated. In those vehicles there were 1,773,446 pieces of baggage which were also inspected. The inspection has been courteously but thoroughly done.

Another precaution made use of in that area which, so far as I know, has not been used to any extent elsewhere in eradication work, is a screening requirement. All railway coaches and cars operating in that area or passing from it to the other parts of the State are required to have screened windows, and either screened or closed doors.

All trucks and vehicles transporting host fruits and vegetables within the area, such as the trucks sent out by commission houses to deliver fruits and vegetables to small towns, and delivery wagons of local merchants used in handling fruits and vegetables, are required to be screened. All host fruits and vegetables placed on display in stores or elsewhere for any purpose must also be kept screened.

The infestation, as I stated, was found at Orlando in the central portion of the peninsula, and within a few miles in every direction from Orlando nearly every property was infested. It was very interesting to note that these infestations radiated out along the highways from

Orlando, which was apparently the original point of establishment. As the distance from Orlando increased, the infestations became more and more scattering. Also, as a rule, they became much lighter. In fact, on getting away from the immediate territory around Orlando and Orange County in which Orlando is situated, there were very few infestations that were heavy.

We hold to the opinion that the fly had not been established in Florida for more than a few months before it was discovered. The work of Dr. A. C. Baker and his studies in Florida of the life history and development of the fly show that the average number of eggs laid by the female is 500. The minimum life cycle is twenty-one days. The average life cycle, under the mean Florida temperature the year around, is thirty-four days, including the pre-oviposition period.

You well know the reputation this insect has for infesting a very large number of fruits and vegetables. You already have records made in foreign countries indicating about seventy host fruits and vegetables for the fly. In Florida, research workers, under Dr. Baker's direction, found all varieties of citrus fruit subject to infestation except sour lime and the Rhangpur lime. In the open fields, peaches, plums, pears, guavas, figs, Surinam cherries, two other species of Eugenia, and maypop have all been found infested. In the laboratory, where studies have been made with the flies in cages under Dr. Baker's direction, about 110 fruits and vegetables have been found subject to infestation. By that we mean that the eggs were not only deposited in them, but the resulting larvae were able to develop and mature in those same materials.

Brief reference to the eradication measures taken and of what they essentially consist may now be made. First of all, of course, inspection is made in the attempt to find all infestations and to delimit the infested area. Essentially three types of inspection are used in the field: *scouting inspection*, which is a rather hasty inspection, was used in the early days of the campaign to quickly delimit the infested area, but is used now scarcely at all; the so-called *standard inspection*, and *intensive inspection*. We now have engaged in the field inspection work in Florida 599 inspectors. These are in addition, of course, to packing house inspectors, sterilization inspectors, permit agents, cleanup foremen, mechanics, and others.

The second important thing in the eradication program is prevention of spread. You can't eradicate anything so long as you continue to let it get into new territory. I have already discussed this feature sufficiently in connection with the quarantine measures. I did omit saying,

however, that in addition to the inspection of automobiles and trucks when they leave the eradication area, no baggage carried by rail is permitted to leave that area without inspection. Hence a plan was devised by which no baggage could be taken on trains unless first inspected for host fruits or vegetables.

Coming now to the direct measures used against the fly itself, these consisted of two principal operations,—*cleanup* and *spraying*. Cleanup refers to getting rid of all materials that were infested or likely to be infested. Equipment was not available in the beginning, but we pressed into service county and city owned trucks. We bought some, hired some, and borrowed some. But, to make a long story short, the official forces engaged in the work destroyed the equivalent of over half a million crates of citrus fruits, host vegetables, and non-citrus and minor host fruits.

The handling of all this material was greatly facilitated by the Administration sending to Florida, from Toledo, practically two train loads of equipment that had been used in corn borer work, some of which could be used immediately on its arrival in Florida, and most of the remainder was of such a character that it could be modified to suit Florida conditions.

Host material was safely disposed of by either of two principal methods. One is burial with plenty of quick lime in a pit, the floor of which has been treated with oil. After a layer of fruit has been put in the pit and limed, about six inches of dirt is placed on top of it and sprayed with oil. Then other layers of fruit and soil may be added, finishing off with at least three feet of soil on top of the last layer of fruit. This final covering of earth is also treated with oil.

The other method developed by the research workers is to grind the fruit and at the same time to sterilize it with steam. The machines developed for that purpose are able to grind and sterilize a large truck load of fruit in about eight minutes.

In addition to the material destroyed by the official forces, it is probable that even more material was gathered by the volunteer citizens' organizations, and by the growers and farmers themselves. Appeal was made to every property owner throughout central Florida to get rid of everything on his place that might possibly serve as material in which the fruit fly could breed, and the response was marvelous. I have never seen anything like it in time of peace, and I don't know whether I ever saw anything like it during the World War. It seemed as though every man, woman and child in the whole area turned aside from their regular

vocations and went to work gathering fallen fruit and disposing of the vegetables in gardens. Boy Scouts, students, clerks, workmen, pitched into making a thorough cleanup of that area, and in a short time it was cleaned up.

That, of course, was one of the direct measures used in destroying whatever larvae might have been present in those fruits and vegetables, and besides breeding places for future generations were cut off.

But in addition, flies that had already matured had to be thought of, as well as those that possibly might mature from material which had escaped destruction in spite of the pains taken, so the so-called bait spray was put into use. This spray was based on the work of Mally and others. The term "bait spray" is a misnomer: fifteen inches is about the maximum distance of attraction. The contact of the fly with the sprayed surface is more or less accidental. When the fly does come in contact with it, however, the bait is readily eaten with fatal results.

The trees are not sprayed all over with this spray as one would spray for scale insects, for example; merely a spot spraying, a dash, probably a pint or half a pint into the head of a large grove tree is all the spraying required. This spray was applied not only to all commercial groves throughout the eradication area, but to vegetation around groves, and to wild vegetation along the roadways. Up to the thirtieth of November 18,554 miles of roadside were sprayed.

Power sprayers were used largely. For the smaller properties in the towns and cities, knapsack sprayers were used. During the height of the spraying season, July, August and September, our record for spraying done by the Administration's own forces ran as high as 110,000 to 120,000 acres of groves a week.

As a further step in the eradication work, it was necessary to maintain a host-free period in the eradication area, a period in which no host fruit or vegetable was permitted to reach maturity and so become a breeding place for the fly. The host-free period extended from April 1 to October 1 in the case of fruits, and for host vegetables from June 15 to October 1. In addition to that, for citrus fruits, the attempt was made to maintain a host-free period throughout the entire State of Florida from the first of April to the first of October.

You will be interested, I think, in knowing what the effort has cost so far, or rather what has been expended. To December 31, the Plant Quarantine and Control Administration has expended on eradication, inspection, identification and quarantine enforcement in Florida $3,782,007.86 and on research $242,904.28. The State of Florida expended to the same date, $126,298.66.

A very important part of this activity, one which could not have been dispensed with, was the research work carried on under Dr. A. C. Baker's direction with the assistance of Dr. L. A. Hawkins of the Bureau of Plant Industry, Dr. Oswald Shreiner, and others from the Bureau of Chemistry and Soils. Representatives from nearly all Bureaus in the Department of Agriculture, and the Florida State Institutions also assisted in this work.

Certain things stand out as very definite accomplishments in connection with the research work: first of all, the development of more effective sprays and combinations of sprays for killing adult flies and, in the second place, the development of methods of sterilizing the fruit to guard against any residual danger of infestation.

Two methods of sterilization have been developed by Dr. Baker and put to extensive use by Dr. L. A. Hawkins. One is a cold method by which the fruit is subjected to a temperature of twenty-eight degrees Fahrenheit for five hours and held at thirty degrees for the remainder of a five-day period. The other is a heat sterilization method, by which the fruit is held eight hours at a temperature of 110 degrees F. Both of them are absolutely effective against all stages of the Mediterranean fruit fly. In the hands of intelligent, careful operators no damage is done to the fruit.

The determination of possible or potential hosts has also been a very important feature in connection with the research work.

Now we come to discuss the results of all this effort. I think that can be given best by a statement of the number of infestations since the work started the middle of April. Between the discovery of the fly on April 6 and the end of that month 364 infested properties were found. In May, 378 more infestations were found. However, before the end of May, cleanup work was well under way, and spraying with the bait spray was also well under way. In June the number of infested properties dropped to 185; in July 64 were found, and in August 8 infestations. Since the twenty-seventh of August only one infestation has been found, and that was on November 16 ten miles west of Orlando. It consisted of four larvae in one orange. There is every reason to believe that this infestation was found in its incipiency.

Of the 1,000 infested properties 999 are no longer technically called infested properties. They have been released from that classification by the Department and by the State Plant Board of Florida, and the fruit produced in them and in their immediate vicinity is handled under exactly the same precautions as the rest of the fruit is handled in the eradication area.

The appearance of this insect in North America is a challenge to economic entomologists. If you stop to think about it, economic entomologists have never done anything really big. Don't misunderstand me. I am not disparaging the wonderful taxonomic work, the biological work and the development of control measures, but the entomologists have never done anything comparable to what the engineers did when they built the Panama Canal. Entomologists have never done anything comparable to the development of a heavier-than-air flying machine, or the development of radio or wireless telegraphy. We, as a group, have never done anything comparable to the eradication of yellow fever from the Southern States in 1905, a job which was essentially an entomological one but which was done by physicians instead of entomologists. As entomologists, we have never done anything that compares with the eradication of the cattle tick from the South, another job that is essentially entomological but instead of entomologists doing it, it is being done by animal industrialists.

We have seen one pest after another secure a foothold in this country in the last forty years, and despite our efforts they have stayed. The time has come, my friends, to do something in applied entomology that will compare with what men in other professions are doing in this day of progress. The more should we do it because we know that the greatest battle man has confronting him is against insects, and we are the men who have been designated and called upon, and are pointed out as the experts to deal with these problems.

If you will stop to think about it, there is no reason or common sense why a foreign pest should be permitted to find lodgment in this country and continue to stay here in spite of entomologists, agriculturists, and everybody else, and forever afterwards take a tremendous toll not only from the producer but from the consumer as well.

As Mr. Strong said to you this morning, the outcome of this effort to eradicate what is acknowledged to be the major fruit pest of the world is going to have a very profound effect on the thought of the public and upon the position of our profession in the next few years. If this undertaking fails, there will probably be no more appropriations by Congress or States for undertaking the eradication of anything, at least for a quarter of a century. On the other hand, if this campaign succeeds it will be a wonderful precedent; it will demonstrate that there is something to economic entomology. If this fly is eradicated now, or in the near future, within twenty-five years intelligent people of this country will wonder why we were such fools as to let a foreign pest invade our shores and have its own way.

It is an opportunity because the progress made in the fight against this thing is almost beyond belief. We admit that what has been done is impossible to do, but it has been done so far as human examination, investigation and inspection can determine. There has not been one development of any kind in the history of the work since April 6 to make any intelligent entomologist believe that the Mediterranean fruit fly cannot be eradicated—not a thing.

Of course, the opportunity that exists now is not going to last. The Mediterranean fruit fly breeds while you go home to dinner and while you are asleep at night. It breeds on Sundays and holidays, and it keeps on breeding while Congress is deciding to make an appropriation. You have to keep up with the fly and keep ahead of it if it is ever to be exterminated. The situation is a critical one. In spite of the insect having been reduced from millions to the point where one only infested orange was found in four months—and that of itself is almost unbelievable—there are people in Florida and in other States writing to Congress opposing the appropriation of any more money with which to complete the eradication.

What more could you ask for than a record such as has been made, as a basis upon which to give further moral and financial support to such an undertaking? You couldn't have any better record than has been made!

I want to say to you now that this is the greatest opportunity with which the entomologists of America have ever been confronted, the opportunity to put their moral backing and to put their backing as men of professional prestige behind Congress, and give the Department of Agriculture the opportunity to finish the job. (Applause)

CHAIRMAN WALLACE: It is now one o'clock. I doubt if we should start any discussion of these papers until after lunch. Is that all right? We will adjourn to meet promptly at two o'clock and take up the Mediterranean fruit fly.

Monday Afternoon Session, December 30, 1929

CHAIRMAN WALLACE: I should like at this time to call on Mr. H. W. Hume, to say a few words to us about the Mediterranean fruit fly before we open up the matter for discussion from the floor.

MR. H. W. HUME: Mr. Chairman and Gentlemen: I suppose that of all the insects that have come to American shores, the Mediterranean fruit fly was the best advertised. It had left a mean streak of history behind it over a period of a century or more, and it was rather problem-

atical as to what it would do or what it might not do under American or under Florida conditions. So thoroughly had it been studied in other lands, and so thoroughly had its work been known, that I have the feeling that even among you—and I am speaking as one apart because I am not an entomologist— there was a feeling of skepticism as to what might be the outcome, and I think perhaps that on the part of some of you there was also a feeling that the undertaking was doomed to failure. I have reason to know that there still is a feeling in some quarters that the situation as it appears to have developed has an unreality about it. But the situation as we have gone through with it has been a very real one. It might be well to remember that over a period of a very few months there has been put into that fight more of men and more of money than has ever been put into any similar undertaking in the same length of time. We ourselves at the other end of the line had thought we might stand in the position in which we find ourselves today at the end of two or three years' time, and I think I may as well say to you that the surprise has been very great to us as it has perhaps been to many of you. I want to point to this fact also in the same connection, that there have been entomologists in Florida from time to time since this outbreak. I think they have had this same feeling of skepticism as to what the situation really was, of what the possibilities of it were, and yet I do not believe that any one of them has come away from the state after looking the situation over with a feeling other than that the work was being carried through to a finality. Exactly where we stand on it, of course we do not know. We cannot know for some months to come, but there appear to be no questions in the mind of anyone who has looked into it but that the situation has been squarely met and that it can be carried through to a final conclusion.

Now there has been criticism in quarters in Florida, for instance, of things that have been done. I do not believe it is possible to carry through any campaign such as we have been through without making some mistakes, and I think those who are closest to the work should sit down now, perhaps, and review the situation and point out things that were done that need not have been done, and yet I will defy anybody to place his finger on a mistake that has been made that has not been made on the right side of the problem.

Is this to be left as it stands, as an unfinished job? Those situations have developed in America before, where an insect was in hand and then got out of bounds and beyond all chance of coping with it on the basis upon which we are undertaking it. Shall we go on and finish it or

shall we stop? The last is unthinkable! We have put into it much of time, much of hard work, much of money. If we stop, that all goes into the discard. As Dr. Newell pointed out this morning, the campaign we are waging in Florida means more to economic entomology than anything that has come before it possibly at any other time. As I said a while ago, here we are meeting a foe that was the best advertised one that ever came to America. Many of those who have come in were practically unknown before they reached our shores. Such certainly was not the case here.

I beg of you in every direction for your support, for your kindly feeling toward the work which is being done. (Applause)

CHAIRMAN WALLACE: Certainly some of you want to ask some questions. The whole situation is open for discussion. Is Dr. Dean here? I should certainly like to hear from him. Dr. Dean, I certainly would like to hear you say a few words if you will about the Mediterranean fruit fly.

MR. G. A. DEAN: I have had a great deal of interest in the remarks that have been made this forenoon and this afternoon in regard to the Mediterranean fruit fly.

I have been surprised at some of the rumors that have come from Florida since a group of us were down there. I was somewhat surprised at some of the rumors that were abroad at the time we went down. I am referring now to the special commission that was appointed by Secretary Hyde to visit Florida, go over the work, visit the orchards, consult with the various business organizations, members of the legislature, growers, small and large, or any other organization in Florida. Of course rumors do start. You must expect that. They always will. Yet I am surprised that some will even think or bring themselves to the place where they might think some of these had some truth in them. I don't want to talk on that. I will simply dismiss it.

Not very long had I returned from Florida when a group of two or three entomologists came to me and said, "Dean, I want the lowdown on the report of this committee."

I asked, "What do you mean by the lowdown?"

"I would like to know whether that report of that special committee endorses the work that has been done, and the work that has already been published to such a place that it is believed it offers an excellent opportunity for eradication, and that the eradication program should be continued by all means."

That was a unanimous report; there is no question about it. There wasn't a person on that committee who went to Florida who did not believe they had just about as well have given their report before they went to Florida, and that to talk eradication of this insect that had already become established was ridiculous. It was unbelievable. There were on that committee some men who had been in big projects, men who could think and analyze situations. I mean outside of entomologists, not saying that there were not some entomologists on there too who had been in some fairly large undertakings. But it was an unanimous report, and it is just as Dr. Hume said a few moments ago. I believe that anyone who will go to Florida and go over the work, see what has been done, analyze it, will be greatly surprised. He can't help believing that things have been done that seemed impossible. Many things that were apparently impossible, have already been done. As I said before, that was a unanimous report of the committee.

We believe that the work even at that time was such that eradication was possible. Many rumors were out when we went down there of the insect living in the great swamps of Florida and everything of that sort, and that there was so much wild fruit that might be infested which it would be impossible to eradicate. How much of it has been found in the wilds? Dr. Hume can tell you, Dr. Newell can tell you how much of it has been found out in the wild fruit. In the last four months, with the exception of one place that Dr. Newell mentioned, nothing had been found anywhere. The survey has been made over what he called the wild lands of Florida, out where the wild fruits have been growing, which may have been cultivated. Dr. Hume found a single infestation in the wild fruits.

MR. HUME: Of the native wild fruits, one has been found infested.

MR. DEAN: That gives you some idea. When we went down there, what was out in the wilds was not the problem at all. The most serious thing as I see it at the present time is that there are groups who are letting themselves believe that things exist in Florida that do not exist at all; that people have faith in or believe the rumors that they are hearing. Of course I will say, too, coming from some of the sources that they have come from, it explains to a certain extent why some people would want to believe them. The thing I want to impress upon you if I can is for you, before you criticize the committees that have been down there, two of them, or before you criticize any of the work and say it cannot be done because it has not been done, to just withhold your criticism at least in broadcasting it until you have had an opportunity to really

look into what has been accomplished in Florida and see the situation as it actually exists. I feel just as Dr. Newell did, if there was ever an opportunity offered to us up to the present time to attempt eradication with wholeheartedness, this is it. Now, since almost unbelievable results have been accomplished, it seems to me that we certainly should lend every effort we have to push the thing to finality, as Dr. Hume has stated.

I don't believe you have heard me talk very much on eradication. There is only one time I ever did and that was about the European corn borer, and I haven't changed my mind very much about that since it started. The eradication of the European corn borer, even if only in Boston or the vicinity of Boston, is a problem entirely different from this one. If we had the time I could name thirty-five or forty reasons why this insect might be eradicated where the European corn borer could not. We haven't time to go over them, but there are some things to be considered if you take the time to analyze them and see what it has really offered toward eradication. I, for one, believe it can be done, and I want to lend my support in any way I can in helping the work. (Applause)

MR. H. H. KIMBALL: There is one phase of this Mediterranean fruit fly work that in my opinion has not been presented to you as fully as it might be, and I am going to take the liberty of saying a few words about it at this time. There always is bound to arise the question of those of us who are interested in the control or eradication of insect pests as to the possibility of that pest having spread outside, way outside, through commercial jumps, of the area that is known to be infested, the area in which the intensive work is going on. It is about that particular phase of it that I should like to say just a few words.

I had the privilege of attending the meeting that Dr. Newell referred to, in Florida, the first meeting that was held in Florida, the original meeting of the Plant Board when the first quarantine was promulgated. So far as I am concerned personally, so far as we are concerned in organization in Mississippi, we have been directly behind the work and intend to stay directly behind it in any way we possibly can.

Immediately after funds became available, a certain amount was allocated to each of the states that had been most seriously exposed, we might say, to infestation. In Mississippi, during the months of June, July and August, we had about seventy-five men in the field scouting the state, looking in wild and cultivated fruits. We have a subtropical section down in the southern part of the state, and we were naturally

concerned very much on that account so far as it affected all of our fruits. So we pitched into it and by the selection of danger centers, which we were pleased to term them, we intensified our work around those sections and made what we believed to be a pretty thorough and careful survey of the state. I happen to know (and I don't believe this point was brought out) that same condition prevails in every one of the states immediately adjacent to or near the state of Florida. The result of our work was entirely negative. We didn't even find infestation in stored fruit. It so happened that practically all of our fruit in Mississippi came from the West Coast, which probably accounts for it. Some maggots were found in stored fruit in other states. We didn't even find maggots in stored fruit in Mississippi. We found no infestation of any description. I can't give you the exact number, but in thousands of inspections and in inspection of many, many thousands of bushels of native fruits in the state, that was the case.

The importance of carrying on that work in the future I do not think can be too greatly stressed, along the lines of the intensive work down in the state of Florida. I am sure the Department will see fit to continue that work if funds are provided. I should like to say that we in Mississippi are very much concerned about it for the protection not only of our own and the Gulf Coast, but for the protection of the fruit all over the state. (Applause)

CHAIRMAN WALLACE: Surely some of you have some questions, something to say about it. I probably should not say anything about it, but I was very much interested in one very particularly dear friend of mine. He quit Florida when the Mediterranean fruit fly came in and came in to see me half a dozen times. Frankly, I didn't believe it could be eradicated. I gave him every reason in the world that it couldn't be eradicated and told him to stay in Indiana. He said, "Is that all you have to say about it?"

I said, "Yes."

He said, "I am going back to Florida. You don't know the people down in Florida. I do. They will do everything you have said and then some."

And he went on back. I haven't heard from him, but he said he was going to stick it out. I think maybe some of us don't know the people down in Florida, but I know some of you have some questions you would like to ask.

MR. A. C. FLEURY: I believe Dr. Newell and Mr. Strong both pointed out the importance of favorable public sentiment toward the success of

eradication campaigns of this sort. I am wondering how long there will be unfavorable public sentiment. Just so long as propaganda not based on facts is continually being thrust before these people in Florida, and those others to whom the Plant Quarantine Control Administration must look for financial support. I am not a scientist, but it seems to me that scientific conclusions should be based on facts. I think it is extremely unfortunate that some scientists have permitted their personal opinions to be voiced abroad, and have given to the selfish opponents of this eradication campaign ammunition which they would otherwise not have to injure the success of this eradication campaign.

It occurs to me, after Dr. Newell's talk this morning, that no person, regardless of whether he is an entomologist or not, but certainly an entomologist, can question the desirability and necessity for going ahead with an eradication campaign of this sort and carrying it out to a successful conclusion. I, for one, am certainly sorry that entomological propaganda has been issued which has given ammunition to those people who are selfishly opposed to the continuation of this eradication program. (Applause)

DR. E. P. FELT: I have not been to Florida, and give voice to any views which I may have with only general knowledge in regard to the situation. It seems to me that unbelievable results have been accomplished and I have nothing but praise for what has been accomplished, and while I admit that mistakes have been made, we expect those in all large undertakings. It seems to me that the crucial point in regard to eradication of the Mediterranean fruit fly or any other insect does not depend so much on what you do in the very beginning, but it is going to depend on what you can do next year, the year after, and the year following, and perhaps the succeeding five to seven or ten or fifteen years, whatever the limit may be. That is, in other words, if you are going to eradicate (and I am using that in a strict sense), you have to carry through to the end. I believe the only way that can be accomplished is by laying out a progressive program. It is not so much what Congress or the state of Florida will grant next year; it is what the federal government and the state will make available through a series of years. I am inclined to feel a little this way: I am not opposed to eradication, but I would be a little inclined to feel that even if you could get an abundance of funds for this next year and the year after and then find it falling through, you might better keep out of the game.

That is just the history, to a certain extent, of the Gipsy moth work in the state of Massachusetts. They had enormous sums for a series of

years. They did good work. I happen to know something about it, and one of the important factors in making it impossible, physically speaking, to eradicate that insect, was due to the very high character of work that had been done. In the eradication of this Mediterranean fruit fly you have to face the situation where the honest administrator must admit that he hasn't seen a fly perhaps for one year, perhaps for two years, possibly for three or four years, and is still asking for one million and a half or ten million dollars, as the case may be, and get away with it. It seems to me that the only thing to do is to go to Congress with a comprehensive program, have them to understand the whole thing and let them know that the last fly is worth all the costs. (Applause)

DR. T. J. HEADLEE: I was one of those who went to Florida very skeptical as to the possibilities of eradication. I came back convinced that the fly could be eradicated. There was the organization to do it and all that was needed was the money. I feel exactly the same way now. What is needed is money, and large amounts of money. The economics of the thing was studied pretty well by Dr. Cooper of the Commission to which Professor Dean referred. While this Commission made no recommendation as to money, amounts, or anything of that kind, the Commission did consider that the probable sum of money necessary to bring about eradication would be a most excellent investment from the standpoint of the United States.

I think that the practical end of this problem today is finance, and finance must come from the federal government. There is no sufficient amount of finance in Florida to handle a situation of this kind.

As far as people in our section are concerned, on that portion of the federal taxes which they pay (and it is pretty sizeable), I don't think there is the slightest objection to appropriations, federal appropriations, being made which carry a part of their taxes to the solution of this problem. I think that is the general feeling. I have had a number of talks with joint organizations, Pennsylvanians and New Jersey men, and as far as I can see that is their reaction, and many of these men are heavy taxpayers to the federal as well as to other taxing bodies. I have not had a shadow of a doubt that this bug can be exterminated. I feel that the only consideration is finance, and that that finance must be granted soon or the work will not be a success and the bug will get away. I agree with what Dr. Felt said about a well set forth program. I believe this organization has that program. I believe that the whole matter is being held up in Congress now because not enough people in this organi-

zation and elsewhere in this country believe that the thing can be done. If it can be done it is worth what it costs.

It seems to me we want to center our efforts, if we are backing this thing and believe it would be worth while, upon that phase of the question.

Now as to counter-propaganda issued here, there and elsewhere, we can take no notice of that except to answer it the best we can. That is a matter of freedom of speech. Every chap has a right to make his own notions known if he can and if he sees fit to do so. We cannot safely deny free discussion, but we should carry our end of this free discussion in a convincing and widespread manner so that we may produce the influence which is necessary to secure the funds.

As to rumors and reports and all that kind of thing, the world is full of them. It makes no difference. I saw nothing in Florida among the people and the conditions (and I will admit to you that I was skeptical and was looking for anything that might turn up) that gave any basis for the idea that the bug could not be exterminated or that the organization was not right. Therefore, my information endorses the work that has been done, the organization that is doing it, and the practicability, with funds, of exterminating the insect. So we must center upon the question of finance, and what this organization can do in that direction is more or less problematical, but I will say to you that if you got out and tried you would be surprised at what you could do, because most of you have got the confidence of your people back home and of men whose word to the Representatives and Senators in Congress mean something. There is, to my mind, in this organization right here and now a corps of men who, if they became active, could insure adequate appropriations for carrying on this work. (Applause)

DR. NEWELL: If I may be pardoned for speaking again, we have discussed the present situation and the past, and not very much has been said about the future. We might give some thought to what is likely to transpire if the eradication of the fruit fly in Florida should fail. The best protection that any state could have, if invaded by this pest, is its extermination. It is better for the battle to fall in the other fellow's territory than in your own. If you have ever been subjected to the losses, the inconveniences due to quarantines which go with a pest like this in your territory, you will appreciate it.

It seems an unquestionable fact that this insect will be able to do great damage to a very considerable number of the major crops in the southern and most of the western states. It is conceivable that it might

be a pest of very serious consequence in what we might call the middle states. In the event it does spread through the country, especially the South and West, I am thoroughly convinced, at least from what I have seen of its capacity for destruction, that it will be necessary to revamp the entire program of agriculture in the South and West. Major crops have passed out in the past because of the ravages of insects and disease, and they can pass out again. If this insect gets a foothold and gets away, I am satisfied that the big commercial peach crop of the South is gone. Whether the citrus industry would go or not, I do not know, but certainly a revamping and a re-arranging of the entire agricultural program, with the re-arrangement of the business structure which rests upon that agricultural program in the South and West, would be necessary. Those of us who have worked in the South know what a revolution in that respect was brought about through the invasion of the boll weevil, but I believe this insect is capable of bringing about a greater revolution, and with it much greater losses in the possibility of adjustment. If that takes place, Congress will be called upon to appropriate many millions of dollars for extending and expanding the research work in agriculture in connection with these changes which will have to be made, and along with it Congress will be called upon and will have to appropriate much larger sums for agricultural extension and educational work than it is appropriating today.

Look at the thing in any way you wish to, anything except eradication means any expense for the United States Government and for the state. When you begin to think it over, you will see that any reasonable amount Congress might appropriate for the complete eradication of the fly will be money well invested, and will be the means of saving a great deal of money not only for the southern fruit man but for the nation.

The President, on December 9, sent a special communication to Congress, which was concurred in by the Bureau of the Secretary of Agriculture, in which he recommended an appropriation of $15,381,000, the great bulk of which was for eradication measures, the balance for prevention of spread, inspection, and importing. That sum, large as it looks, is but a very small part of the annual losses which we may expect in agriculture and business if this insect gets away from us. (Applause)

DR. T. J. HEADLEE: I think we need to get down, perhaps, to a definite point. If I am a little out of turn, I beg your pardon. It seems to me that we need to know how much money, in the judgment of the organization doing the work, is needed from Congress for the coming year. In this organization here men cannot be definite in dealing with

their people without that information. If that is extant, and I think it is from the words I heard from Professor Newell just now, let's hear what it is so that we will know definitely the figure and can talk to it in the places where it will do the most good.

MR. STRONG: The message Dr. Newell referred to is contained in a public document, I think, No. 145. It is available to anyone by writing to a member of Congress. It certainly is available to every member of Congress. It asks for an appropriation, as Dr. Newell pointed out, of $15,381,000. The message by the President stated that if this money was not appropriated, the money we had at that time would be exhausted by December 15. Naturally, we couldn't go right up to the last moment spending the last cent we had, then stopping short. We had good judgment, and business administration would dictate to carry on as much of the work as we could, making things as safe as we could until the money was appropriated.

On the eighteenth or nineteenth of December (I have forgotten the exact date) an emergency appropriation, as such, of $1,290,000 was made by Congress, a joint resolution, and signed by the President the following day. The $290,000 was to replace the ten per cent allocation of funds made by the Secretary of Agriculture from existing funds in the Plant Quarantine and Control Administration diverted to fruit fly work, so that gave us, after the $290,000 was replaced, $1,000,000 to carry on the work in Florida.

This estimate was based on the best judgment of the people who were in the best position to know what was needed for this work, the people actually on the ground in Florida and actually doing the work.

Because $15,381,000 was asked for, doesn't necessarily mean that every cent of that would be expended by next July 1, but we want to be prepared for any emergency which may arise in this fruit fly fight. It may develop that half of that money wouldn't be spent before July 1, but if we need the money we need it right now. We aren't going to be able to say we need a certain amount, and no more. It may develop that more money than that will be needed before the fight is won. It doesn't necessarily mean because that amount was asked for, that every cent is going to be absolutely spent, but we have to have enough money to insure carrying this work to a satisfactory conclusion.

Conditions that existed at the time this estimate was made have not changed in the state of Florida. Save for the finding of the one infested orange in Florida, conditions are identical with the time the estimate was made. That is exactly what the situation is today.

We are not resenting, and we don't care about the criticism that is coming. It doesn't amount to anything except that it illustrates that the same condition exists now as always exists whenever one of these situations arises, that a very few people who object to anything always make themselves heard. The great majority of people keep still. We know that the reasonable people of this country don't want the Mediterranean fruit fly to exist in the United States any place. Anybody knows that.

We know that these quarantine restrictions are burdensome. We want to relieve Florida of these quarantine restrictions just as soon as possible to do it, and we don't want to extend them to every state. The Quarantine Act makes it mandatory on the Secretary of Agriculture to take steps to prevent the spread of insects when they come into the country. The best way to prevent spread is by eradication. That is what we want to do in this case. This is a plain open and shut case. The amount of money is before Congress, directly requested by the President and the Bureau of Agriculture. Conditions have not changed since that estimate was prepared, so far as I know.

MR. STRONG: We expect the work will go on, and I agree with Dr. Felt that a program should be laid out; but at the present time this situation is not so that you can lay out a definite program over a period of years. We have to have this money for the next few months to find out just exactly what we are going to do. There will have to be another appropriation made, certainly.

DR. HEADLEE: I don't know, Mr. Chairman, the best way to organize this thing and shape it up. I am not looking for any job in connection therewith. That is distinctly understood. I am outside the zone of that kind of thing.

It seems to me, to bring this thing to a point, you have to have an organization, and probably the best organization is a good, live, active committee that will keep the boys over the country stirred up and keep things moving. This suggestion I am making may not be in place, Mr. Chairman. I am making no motion because I am not sure, but that is a suggestion of the organization that should be proposed. There should be some.

CHAIRMAN WALLACE: I would hesitate to do anything that wouldn't meet with the approval of the Florida people. They are the ones who know what they are doing. They have their program outlined. Certainly, I would welcome a motion from them, or even a suggestion, and then would appoint a committee, and would like to get a committee that would work with them.

MR. J. H. MONTGOMERY: It occurs to me that we already have an organization which could properly handle the situation as it presents itself today. If there ever was a time since the creation of the National Plant Board and its regional constituent boards when its existence and their existence could be justified, that time exists right now. I know of no organization that now exists, or that could be created, which would wield the influence that the National Plant Board and the regional boards could under this condition which now exists in the emergency that confronts us. That organization and its constituent bodies can reach every single individual, it occurs to me, who is affected either directly or indirectly. As a result of its activities, it certainly should be able to create a most favorable sentiment that would be nation-wide.

Now, Mr. Chairman, while I am on my feet, may I be permitted to touch upon one aspect of this situation which has only been scratched, and that is the effect upon the consuming public of the United States in the event that we have, as the expression is, to live with the fly.

Reference has been made to the cost of eradication. Reference has been made to the economic disturbance in the affected area. Reference has been made to the probable and possible cost of a reconstruction period, but no reference has been made to the effect upon the consumer of foods. An insect of this nature, that can habituate itself and become acclimated over a wide number of areas, with an immense number of host fruits and host vegetables, and with its propensity to create enormous damage, will bring about curtailment of production and you have with it a corresponding rise in the cost of foods. So there is not an individual in the United States who is not affected by the situation which, to many of you, now appears to be a local condition. It is a national problem and not a state problem.

CHAIRMAN WALLACE: Mr. Montgomery, the Plant Board is going down to make an investigation. Whether we could definitely tie up their visit with this meeting or not, I do not know. I see no reason why we could not, and rely on their report to come back here. It certainly represents this body better than any other group that we could get out. Each of our regional boards have delegated representatives and they are going. It would certainly be our report when it came back.

Is there anybody else who would like to be heard?

I almost hesitate to cut off discussion because I consider it of far more importance than all the rest of the things we have put together.

I am going to skip "The Pine Tortoise Scale in Nebraska" for just a moment, and ask Dr. Fracker to take up the "Transportation Systems in Their Relation to the Enforcement of Domestic Plant Quarantines." It ties up with what we have just been talking about.

TRANSPORTATION SYSTEMS IN THEIR RELATION TO THE ENFORCEMENT OF DOMESTIC PLANT QUARANTINES

By S. B. FRACKER and R. A. SHEALS, *Washington, D. C.*

Plant quarantines may be defined as official regulations issued for the purpose of preventing the spread into new localities of plant diseases and insect pests attacking various kinds of plants. They attempt to cover, so far as possible, all means of distribution of the insects and diseases concerned, with the exception of wind carriage and flight which are methods of dissemination over which there seems to be no means of control. The establishment of the present system of plant quarantines has been necessitated by, and its growth has been coincident with, the enormous development of the world's commerce during recent years, which in turn has been brought about by improved methods of rapid locomotion.

The enforcement of plant quarantines must be based on two types of information, first, knowledge as to the products or articles with which the insect or plant disease is likely to be associated and with which it may be carried; second, the means of transportation which may be employed in moving such articles from one point to another. It is our purpose in this paper to outline one phase of the second of these problems so far as it relates to the continental United States.

The transportation of articles in this country for more than the briefest distances involves the use either of highway vehicles, boats, railroads, or airplanes. Of these, automobile and truck transportation is brought under control by road stations, boat movement by port inspectors, and rail traffic by transit inspectors. While airplanes may prove a fertile source of difficulty in the future, articles carried by them are at present handled through established postal and express channels and are therefore available for examination to the same extent as mail and express moved by rail. This paper will be devoted to a discussion of movement by rail and the possibility of examining materials so transported to determine compliance with quarantine regulations.

As each State has hundreds of post offices and shipping points, attempts to control rail movement completely at either source or destination face almost insurmountable difficulties. No quarantine enforcement organization could within a reasonable cost, detail a competent inspector to every post office, express office, and railway station, within a large infested area to be sure that no contraband materials were accepted for shipment. The best that such an organization *within* the infested area can expect to accomplish is to inform the employees of

common carriers of quarantine regulations in order that they may use as much care as possible to prevent the shipment of contraband articles.

Certain of the southern and western States recognizing this difficulty have made provision for inspection at destination rather than the source, but only States having large horticultural interests can afford the expense which an organization of this kind entails. Accordingly, the United States Department of Agriculture has, for several years, been giving attention to the possibility of enforcing quarantine restrictions with respect to movement by rail by the examination of materials *in transit* at strategic distribution points. The success of such a system depends on the extent to which inspectors at a limited number of points are able to make observations on a maximum proportion of the total traffic involved.

The function of the transit inspectors is not to determine the presence or absence of pests in the material passing through their hands, but to ascertain that the safeguards required by the control regulations have been complied with. As examples, they make sure that nursery stock from the Japanese-beetle-infested area bears Federal certification showing that the material has been inspected and found free from infestation; they determine that no embargoed plants, such as white pines from white-pine-blister-rust infected States, are moving to non-infected States, and that currant and gooseberry bushes, are shipped dormant or defoliated from the blister rust infected sections of the country; they check on shipments which may contain cottonseed or other cotton products from pink-bollworm or Thurberia-weevil-infested areas; and they are given the responsibility of seeing that railroad cars which have been employed in the transportation of host fruits and vegetables from the territory under regulation on account of the Mediterranean fruit fly outbreak are cleaned at the unloading point before being sent back to loading territory, where any infestation which there might be in the car would prove especially dangerous. Shipments found to be moving in violation of quarantine are turned back to the shipper and the evidence is referred to the field quarantine unit concerned for investigation and possible prosecution.

Parcel Post. The Post Office Department, which has complete jurisdiction over the mails, has established a definite scheme whereby parcel post shipments to points 150 miles or more from places of origin are consigned to and sorted at one or more of 47 terminal transfer stations. These concentration points are located at strategic railroad junction centers throughout the United States. All parcel post is

consigned through the mails in one of three ways, namely: in sacks addressed direct to one of the 47 terminal stations, in station-to-station sacks ("directs"), or as outside mail.

Sacks addressed to a terminal usually contain parcel post consigned to points in a single State and are sent direct to the terminal at which, according to the postal scheme, such shipments are to be distributed. For example, parcel post from New England to California is sent direct to the Van Buren station at Chicago, sorted there and sent on in sacks to towns of destination in California.

Station-to-station sacks ("directs") are used when there are enough consignments from a certain post office to a definite point of destination in any State to fill a sack. Such shipments are consigned direct to destination without being sorted at any point en route.

Outside parcel post consists of shipments too bulky to be inclosed in sacks, shipments of a perishable nature (nursery stock is not classed as perishable by the Post Office Department) and special-handling packages. They do not go direct to the main sorting rooms in the terminals. Space is usually provided in the basement or on the track level of the railroad stations where such shipments are distributed on trucks, according to the train on which they are to be dispatched. Outside parcel post and direct sacks are frequently transferred direct from train to train. This practice is called direct transferring and takes place only when close connections are made between trains.

Transit inspection methods are based on studies of the routings used by the Post Office Department and the common carriers. The 47 terminal transfer points mentioned are the "bottle-necks" through which more than 95% of all long distance shipments of parcel post, express and freight are consigned for distribution and at which they are available for inspection.

Under an arrangement with the Post Office Department, parcel post packages may be checked by inspectors of the United States Department of Agriculture as to compliance with plant quarantines at any point where the packages themselves can be seen. The so-called outside parcel post to which reference has been made may obviously be examined at any point en route when it is outside the mail car or where the car is opened, but since most shipments for any considerable distance go in sacks addressed to terminals and while en route are not outside such sacks except within the terminal office building, the most desirable points at which to inspect parcel post are the distributing offices in the 47 cities referred to. About 18 of these cities are of much less conse-

quence than the remaining 29. The Department of Agriculture has thus far done some work in about half these 29 important terminals and it is hoped that as funds are made available inspectors may be placed in the others at least during the season involving the greatest danger of transportation of plant pests. It is not anticipated that under present conditions the 18 smaller stations are likely to require attention except possibly for short intervals during the spring and fall nursery stock shipping seasons.

Within the terminal, parcel post shipments are all handled one or more times by the postal employees. These employees have in most cases had several years' experience and their ability to determine the nature of the material inside packages is surprising. The postal authorities cooperate by instructing these employees to hold out for inspection all shipments containing plants or plant materials or any shipment they may have reason to suspect may contain materials subject to Federal plant quarantines. The inspectors also have access to such shipments. The superintendent of one of the largest terminal points stated, after studying the work of our men in cooperation with those of his own force, that he could not see how a single shipment containing materials subject to Federal plant quarantines could pass through that station without being held out for inspection. Owing to the excellent spirit of cooperation on the part of postal employees, it is thus possible for one Department of Agriculture inspector to check on all packages containing perishables originating in, destined for, or passing through cities even of considerable size, although obviously a number of inspectors are required to take care of the entire traffic of such cities as Chicago and New York.

Express. The methods of routing of express shipments are comparable to a large extent with those outlined for parcel post except that practically all express shipments travel as outside packages. Sacks and other containers are used only in case of certain shipments of high value. The express sorting rooms are usually located in buildings adjoining the railroad stations, although in some large cities, due to congestion, the Railway Express Agency maintains separate express yards in the outlying sections to which all incoming express cars are consigned for unloading and from which local dispatch and transfer operations are made. These yards or separation stations are located at strategic railway junction points, usually in the same cities as postal terminals.

Some direct train to train transfers are made. Such operations take place on the train platform at the railroad stations.

Inspection of express shipments presents a comparatively simple problem. The packages are usually wrapped in such a way that the contents may be readily ascertained. The waybills contain the consignor's declaration of contents and while such declaration cannot be absolutely relied upon, it serves as an assistance to inspectors.

In sorting rooms and in the cars, express employees assist materially by piling shipments of nursery stock and other materials subject to quarantines in places where they may readily be inspected. The inspectors do not rely on express employees to hold out shipments. Regular inspection tours based on train schedules are made, and during these trips, inspectors make the rounds of the sorting rooms and the loading docks where outbound shipments are being loaded prior to train dispatch. As a rule a few trains carry the bulk of shipments to be inspected. Such incoming trains are included in the tours and inspections are made either prior to unloading or at the separation docks immediately after unloading and before separations are made.

Studies of direct train to train transfers have also been made and all important transfers are included in the tours.

The cooperation of the express officials and employees is excellent. During preparation of the tours in Chicago, express employees were stationed for a period of more than a week at each incoming express car and exact counts of all shipments of nursery stock unloaded were made. This information was of material assistance in enabling inspectors to know from what points and on which trains such consignments are made. Inspectors have information in advance of any change in train schedules and are thus able to arrange their tours to correspond.

Freight, Less Than Car Lot Shipments. Shipments by freight are made in one of two ways, as full car lots or as less than car lots (L.C.Ls). These two methods offer entirely different transit inspection problems.

L. C. L. shipments are transferred from one car to another at concentration points where they are available for inspection. In some instances, a shipment may be transferred several times at different points until a full car for the destination concerned is assembled. If only a few consignments are available for a given point, they are usually sent by local way freights to destination.

The number of freight transfer points at a large city may be very great. In Chicago for example there are 250 freight yards scattered throughout the city. It is obviously impossible for a force of five men (the average number of inspectors available in Chicago for the past two seasons) to visit all these points each day. The freight companies

cooperate in helping solve this problem whenever requested by furnishing inspectors with copies of waybills covering all plant shipments. These waybills are received prior to the arrival of the shipments. Arrangements have been made whereby the freight agents report each day by telephone the number of shipments on hand and the waybill numbers. The tours are arranged from information thus obtained.

The exact location of the shipments in the cars on the sidings is obtained from the freight box office. The declaration of contents given by the consignor on waybills may be relied upon to a greater extent than in case of express waybills because freight rates are based to a great extent on the nature of the contents. The freight companies have men employed to check on false declarations.

The usual type of shipment by freight is easily inspected. In most cases the removal of one board allows inspection of the entire contents. If individual wrapped packages are contained in a shipment the problem is more difficult. Occasionally the material is so tightly packed that inspection en route is not possible. In such cases inspectors report the shipments to the State inspectors at destination. Several violations have been intercepted in this manner.

Car Lot Freight Shipments. Car lot shipments go direct from point of origin to destination without being transferred en route. Their compliance with quarantine regulations can often be determined directly from the waybills and accompanying papers.

The manner in which this works out in enforcing plant quarantines is well illustrated by the problem of enforcing the Mediterranean fruit fly requirements subsequent to the outbreak of that pest in Florida. Control of the transportation of Florida host fruits and vegetables (after the elimination of mail and highway movement by direct embargo under the Federal quarantine) resolved itself into, first, governing the movement of solid cars of fruit; second, controlling individual box shipments sent by express; third, preventing reshipments of fruits authorized movement into the north but prohibited transportation into the south; and fourth, the enforcement of car-cleaning requirements and preventing the transportation of uncleaned refrigerator cars which had been used for the transportation of Florida host fruits and vegetables, from the unloading point to new loading territory.

The physiography of the eastern United States is such that while there is a general network of railroads which may be noted on any railway map, practically all movement between the northeastern States and the southeastern States, whether such movement is northbound or

southbound must go through the city of Washington. This fact has resulted in the development of extensive freight yards known as Potomac Yards, Virginia, on the south side of the Potomac River. Except for a railway line through the Shenandoah Valley, the next point west of Potomac Yards through which traffic can reach the northern States is at Cincinnati. Control of movement at Potomac Yards with respect to shipments from Florida means that all products going into the heavily populated consuming markets of New York, New Jersey, Pennsylvania and the New England States (an area which includes more than one-third the entire population of the United States) may be seen in these freight yards. It has, therefore, been possible from the first day that the quarantine was established to be sure that the movement of fruit into this important consuming area was confined to shipments made in full compliance with the regulations and without serious danger of bringing the Mediterranean fruit fly.

Points at which the Ohio and Mississippi are crossed by rail offer similar opportunities. From Cincinnati west to the Rocky Mountains, the freight yards at Louisville, Evansville, Cairo, St. Louis, and Kansas City, practically control distribution.

Florida, fortunately from the standpoint of quarantine enforcement, consists largely of a peninsula, with the railroads leaving the State either through Jacksonville or Pensacola, and farther north passing through three or four important distribution points, the most significant being Waycross, Savannah, and Atlanta, Georgia. It was possible for inspectors checking on waybills on freight trains at these points to be sure during the summer and fall (prior to November 21) that no Florida host fruits or vegetables were billed to points in the southern States except for diversion to the north, and once they reached the north such shipments were under full control by inspectors located at the junction points named. A full record of every car of perishables passing Jacksonville and Waycross is received every day by the Domestic Quarantine Office of the Administration and any irregularities are readily detected either at Washington or before the cars leave the State.

This same development of the transportation system made it possible to bring the car-cleaning requirements into operation with the least possible delay. Florida host fruits and vegetables in car lots are normally consigned to 200 or more cities in the northern United States. To place inspectors at all of these points was out of the question. Several representatives of the Administration were assigned the duty of traveling from point to point and familiarizing the railroad employees concerned

with the requirements of the regulations, but the most important enforcement measures consisted of the establishment of inspection of empty refrigerator and ventilated cars after these cars left the unloading point and were moving again to loading territory in the south and west. Six employes of the Department at the junction points named, with a limited amount of assistance from railroad employees, have been able to inspect practically all such southbound empty refrigerator and ventilated cars and see that those which have not been properly cleaned are diverted to cleaning yards at the junction points themselves. The railroad on which the uncleaned car is found then in some cases charges the cost of cleaning against the railroad which had the car at the time it was unloaded, but in any event the car is not allowed to proceed to loading territory until it has been thoroughly cleaned.

This discussion of the Mediterranean fruit fly quarantine enforcement has been introduced as illustrative of the manner in which a knowledge of the transportation systems of the United States may be used in the enforcement of a particular quarantine. There are a few bottlenecks through which practically all traffic between important sections of the United States must move. These are partially due to the presence of mountains, rivers and other physiographic features and their effect on the engineering requirements of railroad construction, but more largely to the fact that the railroads themselves have taken advantage of these features by establishing at strategic points a limited number of freight yards and express distribution platforms at which the transfer of cars or less than car lot shipments from one railroad to another may be arranged. By taking advantage of these features of the transportation systems of the United States it is possible for those interested in the spread of plant pests to prevent the transportation from infested to uninfested sections of the United States of materials which might be carrying plant pests to new localities.

RESULTS. The number of interceptions of quarantine violations reported by transit inspectors since the work started was shown in tabular form. The work was originally undertaken by the Office of Blister Rust Control of the Bureau of Plant Industry and, prior to 1927, was confined to the enforcement of the blister rust quarantine. Since then, inspectors have intercepted as many violations of other domestic quarantines as they could discover, the work being supported by assignments of funds from the special appropriations for the enforcement of the various quarantines. Under the pending agricultural

appropriation bill for the fiscal year 1931, provision is made for the establishment of this work as a separate project.

CHAIRMAN WALLACE: The next paper is "The Pine Tortoise Scale in Nebraska," by L. M. Gates.

THE PINE TORTOISE SCALE, *LECANIUM NUMISMATICUM* PETTIT AND McD., IN NEBRASKA

By L. M. GATES

ABSTRACT

The pine tortoise scale, *Lecanium numismaticum* Pettit and McD., has recently caused serious injury to plantings of Jack pine and Scotch pine in the sandhill region of Nebraska.

An application of a commercial white oil emulsion used at 2% to 3% strength during the first two weeks of July, gave excellent control of the insect without injury to the trees.

The pine tortoise scale, *Lecanium numismaticum* Pettit and McD., was first reported in Nebraska in April 1911. This infestation was in eastern Nebraska. Two other localities in this part of the state reported infestations of this insect in 1919 and 1923. In 1916 an infestation was reported in the heart of the sandhill region near the town of Thedford and in 1924 another report was received from the sandhills in southwestern Holt county. In 1928 the insect was found for the first time in the Nebraska National Forest near Halsey, where over twelve thousand acres have been planted to pines during the past twenty-five years.

The size and importance of this planting as well as the value of the many ranch plantings in the region made it seem advisable to determine if possible the source of the infestation in the forest reserve and to work out practical control measures for this pest, which had already demonstrated its ability to not only seriously retard the growth of the trees but also in some cases to actually cause their death.

The first step taken was a survey conducted during 1928 and 1929 by the Supervisor of the Forest Reserve and the Extension Forester of the College of Agriculture co-operating with the State Department of Agriculture. This survey revealed three, more or less, isolated areas of infestation. One of these was about twenty miles northwest of the forest reserve and the other two about seventy-five and one hundred miles respectively, northeast of the reserve.

Approximately one-third of the plantings inspected were found to be infested with scale. In some cases very little damage was apparent

while in others many of the trees were either dead or dying. Badly infested plantings were easily located, even from a distance, by their darker color caused by a black fungus growth on the honey-dew secreted by the insects.

SOURCE OF INFESTATIONS. Although some of the infestations near the forest reserve were severe and apparently of several years standing, the center of infestation seemed to be in southwestern Holt county where an experimental planting was started in the spring of 1891. The Jack pine trees in this planting were seedlings "dug from the forest in Wisconsin" except a few nursery grown plants used for comparison. At the time of the survey most of these Jack pine trees were dead while Western Yellow pine trees which are not attacked by the scale, were healthy and vigorous. It is interesting to note that the trees constituting the first reported infestation in the state were also thought to have been dug or pulled in Wisconsin. Furthermore, *Lecanium numismaticum* was described from specimens collected in Wisconsin.

From this evidence it seems probable that the original infestation in the sandhill region may have been the 1891 planting and the source of the pest the Wisconsin forest pulled seedlings. Also it seems that the insects have been carried in the crawler stage, from one planting to another by crows or other birds. Crows are very abundant in the sandhills and the pine plantings seem to be especially attractive to them as roosting and nesting sites.

It was at one time thought that the scale was introduced into Nebraska on young Jack pine trees from Minnesota since many of the ranchers secured their planting stock from a nursery in that state. However, the owner of the nursery does not seem to have been familiar with the pest according to a letter received from him. Also, in one instance two neighboring ranchers planted trees from the same shipment from the Minnesota nursery and one of these plantings has no infestation while the other is badly infested. The two plantings are less than two miles apart and have been planted about fifteen years. Furthermore, the first planting of Jack pine in the Nebraska National Forest consisted of seventy thousand wildings from Minnesota and no scale was found in this planting until twenty-five years later.

While this species or a similar one has been reported from eastern nurseries by Dr. L. O. Howard, from New Jersey by Dr. T. J. Headlee, and from the south by E. W. Hadley, we have no records of trees being brought into Nebraska from these regions. Recently it has been reported doing serious damage to Jack and Scotch pines near St. Paul, Minnesota.

LIFE HISTORY. A detailed study of the life history of this insect has not been made. However, it has been observed that there is but one generation a year in Nebraska and that the females winter in about a half-grown condition. The males apparently emerge in the fall, their white cocoons being conspicuous on the infested branches at that time. The first crawlers were observed in the laboratory about June 8th and by July 1st they had practically finished hatching in the field.

HOST PLANTS. Only Jack pine and Scotch pine have been found infested in the sandhill region of Nebraska although Austrian pine is grown in the infested region and Western Yellow pine is quite common.

CONTROL. The first remedy suggested was kerosene emulsion which did not prove satisfactory both because it failed to control the scale and because it sometimes was injurious to the trees. It was later suggested that by cutting out all infested trees the insects would be eradicated. This method has been used in the National Forest with apparently good results. Three infested areas totaling about two acres of trees have been cut out in the past two years and at this time none of the insects are known to be present on the reserve. However, it is realized that there may be some survivors that will cause a new outbreak later. The cutting method has been used for several years on one of the ranch plantings but eradication has not been accomplished and the rancher is becoming fearful that he will eventually lose all of his trees.

Since the state authorities wish to encourage tree planting, the recommendation that the trees be cut out seemed a little inconsistent and it was therefore decided that an experiment in spraying would be desirable. To that end the State Department of Agriculture purchased a power sprayer in June 1929, and in co-operation with the College of Agriculture, the State Game, Forestation and Parks Commission, the California Spray Chemical Company, and the U. S. Forest Service started the sprayer in the field July 3rd. The intention was to apply the spray during the hatching period. However, no crawlers were found during the time the sprayer was in operation, most of the insects being newly established on the twigs without the waxy covering with which they are eventually covered.

The spray materials used were Volck light, Volck heavy, Ortho-Kleenup and, in combination with the first two, "Black-leaf 40" at the rate of 1–800. The oil emulsions were used in dilutions of 2%, 2½% and 3%. Both Jack pine and Scotch pine were sprayed. The spray material being applied under 275 pounds pressure with an orchard spray gun. The weather conditions were not favorable for use of oil

sprays, being hot and humid. In spite of these adverse conditions no burning has been reported on any of the sprayed trees. Furthermore, very good control was obtained. In some of the plantings no live scale could be found a month after the trees were sprayed. Other plantings showed some live scale that were apparently missed when the spray material was applied. Even these plantings showed much improvement in the condition of the trees.

An additional experimental spraying was applied on two plantings October 15, 1929, consisting of Orthol-Kleenup at 6% strength. One of these plantings had been previously sprayed and very good control obtained, the other had not been sprayed before and some of the trees were heavily infested. There has been no check-up of the results of this spraying.

Plans have been made to continue the experiment with dormant strength oil sprays just before growth starts in the spring. This should give information as to whether summer, fall or spring spraying is most effective.

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CHAIRMAN WALLACE: We will now hear a paper by E. L. Chambers.

HOT WATER TREATMENT OF NARCISSUS BULBS IN WISCONSIN

By E. L. CHAMBERS, *Madison, Wisc.*

While Wisconsin is not one of the states in which narcissus bulbs are being grown on a commercial scale, there are two firms in the state that force annually nearly a quarter of a million of these bulbs. Both of these florist establishments are located at Milwaukee, one growing the bulbs that it uses for this purpose while the other purchases forcing stock from out-of-state sources each year. In order to make sure of an adequate supply of good quality vigorous forcing stock to meet their needs after the embargo was to go into effect during the fall of 1926, the Holton & Hunkel firm was compelled to grow their own stock. While this project

was first undertaken in 1924, it was necessary to secure several tons of bulbs in 1926 just prior to the time when the embargos became effective. In order to comply with the requirements of the narcissus quarantine at that time they were obliged to arrange for the treatment of the bulbs with hot water, recognized as a means of controlling infestation by the nematodes, *Tylenchus dipsaci* Kuhn, and the bulb flies, *Merodon equestris* and *Eumerus* spp.

When the firm attempted to purchase such equipment as would be adequate to provide a temperature ranging from 110° to 111.5° over a period of 2½ hours, as specified by the requirements of the quarantine, they found that such apparatus was not available on the market and consequently set about to devise their own. Mr. H. H. Hunkel of this firm at first considered it almost humanly impossible to maintain a temperature at the limits set by the quarantine regulations but was able in a few months to build a sterilizer which met these requirements almost to a point of perfection and has used it successfully over a period of four years.

This equipment, consisting of a large round bottom rectangular, iron tank, with an agitator, rotary pump, and a boiler, was built out of doors. The tank is 8 feet 6 inches long, 3 feet 3 inches wide, and 4 feet deep to the bottom of the curve. It is sufficiently large to take care of 5 trays holding approximately a half ton of bulbs at one time. The trays, covered with quarter inch wire screen, are built so that they will set down into the water with the weight resting on the handles at the top which extend over the sides of the tank to permit of easy handling and at the same time hold the trays a foot off of the bottom. The tank is mounted on a frame elevated on legs a foot above the ground. Stationed about four feet from one end is a 2 H. P., internally fired, steam boiler connected to the tank with ¾ inch pipe leading to the opposite end where it enters from the top of the tank, running down the inside to a point at the base of the rounded bottom. Here at this point there are installed two brass 8-inch propellers, four feet apart and reversed, on a shaft running two-thirds the distance of the bottom of the tank. This shaft is driven from the outside by a chain on an 8-inch sprocket wheel driven by a 4-inch sprocket wheel on another shaft running the length of the tank at the level of the top. The opposite end of the shaft drives a 4-inch pulley on a rotary pump with a belt leading to a 10-inch pulley. This shaft is driven from a 10-inch pulley at the opposite end where it is connected by a belt to a 2 H. P. electric motor, making 1750 revolutions per minute. The pump will deliver about 50 gallons per minute and the

agitator makes about 850 revolutions per minute. The steam boiler is only 18 inches in diameter and 44 inches high but has sufficient capacity for twice the load it carries in doing this work.

In operating the sterilizer the water is first heated by running live steam into the partially filled tank. To offset the cooling temperature effect of the bulbs the temperature is first raised to about 115° F. It takes from three to five hours to do this, depending upon the outdoor temperature and the amount of wind. The bulbs are then inserted in the trays and the pump circulates the water through a heater adapted for this purpose. A heater was mounted midway between the pump and the top of the tank on the 1½-inch pipe returning the water to the agitator at the opposite end of the tank and running parallel with the steam line. This heater consists of a 2-foot length of an 8-inch pipe with a ¾-inch copper coil running through it into which steam is circulated and the water is heated as it is pumped over it. While the amount of steam needed to maintain the desired temperature for a period of 2½ hours might be secured by simply "cracking" the valve to allow the necessary amount of steam to pass, a more satisfactory control was worked out by a cut-off consisting of a series of four valves arranged on different sizes of pipe having a range of 3/8", ½", ¾", and 1", respectively. While some adjustment has been necessary with unfavorable weather conditions it has been frequently possible to run the desired temperature for almost the entire period without making any adjustment. Although it was thought at first that getting a control within a degree would be next to impossible, it has been demonstrated in the four years the machine has been in use that even a very small fraction of a degree variation can be secured.

Such a pronounced invigorating effect was noted from the use of hot water at the required temperature that while the owners of this equipment do not make any shipments which would require the continuing of this treatment, they feel it well worth while to continue for their own good. The bulbs used for planting out for propagation are planted as soon as they are cool, the bulbs are spread out on a packing house floor to dry sufficient to permit of convenient handling and then planted before they become completely dry. Those used for forcing are of course allowed to dry off until needed for forcing.

Another firm in Milwaukee, forcing around 100,000 narcissus each year, sells its forced bulbs each fall in small lots and to comply with the quarantine regulations it was necessary one year to have their bulbs treated with this equipment before certification, although only a trace

of one of the species of nematodes was found, otherwise the bulbs could not have been disposed of. The bulbs are treated usually during the last week of August or the first week in September.

In the four years that this treatment has been in use no injurious effects have been noted from its use and 100% control has been secured of the various nematodes, bulb flies, and in addition the bulb mite, *Rhizoglyphus hyacinthi*, which sometimes becomes very abundant on bulbs in Wisconsin. The bulbs used for forcing are found to bloom a week or so earlier than checks which were not treated and the color and quality of the bloom has shown a decided improvement. Certain varieties, such as Von Sion, which fail to produce good color in Wisconsin were at first thought to be a result of hot water treatment but it has later been demonstrated that the untreated ones grown here along side of those treated, also showed a tendency to a green tinge in the bloom. This variety, which does well out of doors, is a very prolific bloomer and multiplies rapidly, is being abandoned in Wisconsin although until recently most extensively grown of any of the varieties. With the exception of this variety the Holton & Hunkel Co., has been able to grow just about as good forcing stock as they formerly imported and each year they are gaining experience which enables them to improve on the quality. Bicolor Victoria, Emperor, Spring Glory, Golden Spur, Martha, King Alfred, and Empress are the principal varieties now being successfully grown in Wisconsin for forcing. Basal rot, while present, has not been of sufficient importance in Wisconsin to require any additional precaution in treating with hot water, the visibly infected bulbs being sorted out when they are cleaned preparatory to treating.

CHAIRMAN WALLACE: The next paper is by Dr. K. C. Sullivan.

THE PRESENT STATUS OF THE PLANT INSPECTION WORK IN MISSOURI

By K. C. SULLIVAN, *Plant Commissioner, Missouri State Board of Agriculture*

The Missouri State Board of Agriculture in 1869, published C. V. Riley's first Missouri report on "Noxious and Beneficial Insects." This was the first of a series of nine brilliant reports, and the first important entomological work carried on west of the Mississippi River.

Thus the Missouri State Board of Agriculture was a pioneer in fostering entomological work. The Board, however, discontinued its support of entomological work when Riley left Missouri, and it was not resumed until the present time. The resumption of support of this type of activity has been brought about by the rapid development of the in-

spection and regulatory phases of entomological and plant pathological work. This development of the inspection and regulatory work has undoubtedly been due to the fact that the public has come to more fully realize the great importance of preventing, eradicating, or controlling those insect pests or plant diseases which compete with man for food upon which to live.

Laws governing the transportation, and disposition of materials which may serve as a means of bringing about the dissemination of insect pests and plant diseases are unfortunately of quite recent origin. Their economic value, is now, however, recognized by most everyone. As time goes on, we will without question resort still further to our legislative bodies for legal instruments to assist us in the warfare against our insect enemies and plant diseases. It is probably unfortunate that it is necessary to resort to legal action in carrying on the fight against insect pests and plant diseases, for the enforcing of laws sometimes develops into an unpleasant task. I am of the opinion, however,that at this time, in the light of present day knowledge, our laws pertaining to insect and disease control, are very effective weapons, especially when supported by scientific facts, and judiciously administered.

The first law in the State of Missouri, pertaining to insect pest and plant disease control, was enacted in 1913. It referred particularly to nursery stock, and was placed under the direct administration of the Agricultural Experiment Station, with the Department of Entomology in charge of the work. This was probably due to the fact, that previous to 1913, the Department of Entomology, of the Missouri College of Agriculture, had voluntarily inspected for a number of years, the nursery stock of those nurserymen who wanted to make shipments to other states. It was very natural therefore, that the Department of Entomology, of the College of Agriculture, should be asked to carry out the work of the first Plant Act. This first act remained in force until 1925, and did much to improve the situation in Missouri. The one difficulty was, that the Experiment Station disliked to institute legal proceedings against violators, for fear that unfavorable reaction against the Station might possibly result.

In an attempt to remedy this situation the General Assembly in 1925 removed the administration of the Plant Act from the Agricultural Experiment Station and placed it under the control of a State Plant Board, which was composed of three members, the President of the State Board of Agriculture, the Director of the Agriculture Experiment Station and the President of the State Horticultural Society. The

entomologist of the Experiment Station was designated by the amended law as the State Entomologist and Chief Inspector. There was no change in the actual performance of the work. It was still directed by members of the Experiment Station staff, though administered by an independent Board. By this time, however, the regulatory work had become firmly established and was obtaining some support through state appropriations. The agricultural and horticultural interests had come to realize the great importance of the regulatory work.

In the meantime a number of dangerous insect pests and plant diseases had become firmly established in different parts of North America and it was evident that in a short time Missouri would be faced with the problem of combating some of these pests within her own borders. It was, therefore, thought best to place the regulatory work under the administration of the State Board of Agriculture, the official administrative agency of all agricultural regulatory acts in Missouri.

The General Assembly of Missouri, therefore, abolished the State Plant Board and transferred the administration of the Plant Act to the State Board of Agriculture. The transfer became effective August 27, 1929, and the Plant Division of the Missouri State Board of Agriculture was organized a few days later. The chief administrative officer is designated as the State Plant Commissioner with headquarters in the Capitol Building at Jefferson City, Missouri and the Plant Commissioner has complete charge, under the Board, of the inspection and regulatory work.

The Board of Agriculture itself is a bipartisan Board composed of sixteen members, appointed by the Governor, one from each congressional district, besides three ex-officio members. The members of the Board are vitally interested in the agricultural welfare of the state and they take a keen interest in the work which the different Divisions of the Board carries on.

There is every reason to believe that the plant inspection work, as it is now administered, will develop rapidly. The Board has adopted the important policy of employing only men in the Plant Division who have had the necessary technical training to fit them for the work. With the exception of the clerical force every employee of the Plant Division is a graduate of an Agricultural College.

The new Plant Division of the Missouri State Board of Agriculture, is in a position to be of real service to the agricultural and horticultural interest of the State, and its institution may also be significant, in that it marks the resumption of entomological work by the Missouri State Board of Agriculture.

It may be said, therefore, that this substantial state institution, the Missouri State Board of Agriculture, has again, after so many years, assumed the task of assisting Missouri farmers and Missouri fruit growers with not only their insect problems but also with their plant disease problems.

It is fully realized, however, that the work which Riley did in Missouri, can never be surpassed. If the present Plant Division can render only a small per cent of the service as was rendered by Riley, its creation will be fully justified.

CHAIRMAN WALLACE: The next paper is by Messrs. Jones and Boillot.

HOW THE PLANT DIVISION, MISSOURI STATE BOARD OF AGRICULTURE, SERVES THE FRUIT GROWER

By GEORGE D. JONES and B. F. BOILLOT

The Plant Division of the Missouri State Board of Agriculture, though only four months old, has made a serious attempt to be of service to the people of the State, and since this paper is to deal with the services of the Plant Division to the fruit grower, only the functions of the Division pertaining to horticulture will be considered.

These services may be grouped under two more or less distinct types, namely—protective and informative.

The protective services consist of the control of the movement and disposition of plants and plant products, which may serve as a means of disseminating dangerous insect pests and plant diseases. All nursery grown plants legally handled in Missouri, are produced in certified nurseries, sold by certified agents or dealers, and confidently bought by the fruit grower to be visibly free of insect pests and plant diseases. The Plant Division functions as the regulatory body, in that it makes inspections of all nurseries within the State at least once each year, and if necessary, oftener. These nurseries, if found free of dangerous insect pests or plant diseases, they are certified; if found infested or infected, all clean up work is carried on under the supervision of the Plant Division, and no infested or infected stock, is allowed to leave the nursery. All nursery stock which has been subject to infestation, but visibly clean, will be either fumigated or dipped.

It is also the duty of the Plant Division to see that nursery material is handled in no other way, than through certified concerns. There are many dealers in nursery stock who find it more profitable for the time being, not to do some of the things necessary for the prevention of the

spread of insects and diseases. These dealers frequently must be reminded of their duty, which is to handle only certified material, and to keep records of sales and purchases.

The fruit grower is not only protected against infested home grown material, but is as well protected against material grown in other states. Even though the Plant Division at the present time accepts the certificate of inspection of all other states, yet it reserves the right to inspect any shipment at any time as seen fit by the Plant Commissioner. Thus all nursery stock eventually reaching the Missouri fruit grower, is directly under the surveillance of the Plant Division.

Another potential, though not at present active service, is the power which the Board of Agriculture possesses to establish and enforce quarantines against dangerous insect pests and plant diseases. Incidentally three quarantines are in force now; none of them directly affect the fruit grower, still the knowledge, that when necessary, a quarantine will be enacted, creates quite a bit of assurance among the fruit growers, that the Plant Division functions for their protection and service.

The other type of services rendered to the fruit grower, is of an informative nature, not the result of researches, but the results of surveys and observations.

During the past season, nearly 8000 acres of commercial orchards were surveyed. The fruit growers seem to appreciate this service and are pleased to obtain information and assistance in combating any insect pest or plant disease present. During this same survey, the extent and location of the infestation of a new species of apple mining insect, was determined.

A brief bit of history of this apple mining insect carries us back to August of 1928, when an unknown Lepidopterous larva was found to be attacking ripening apples near Waverly, Missouri. The larvae has been identified as belonging to the genus Carposina, a group of small moths; some species of which attacked certain fruits in different parts of the world, particularly the Orient. Adults have not been obtained up to the present time. The insect now for convenience, called "Carposina," was found in thirteen counties variously located in Missouri.

Ten different varieties of apples found to be infested, namely—Grimes, Jonathan, Huntsman, Willow Twig, Minkler, Gano, Ben Davis, Senator, Ingram, and York; named in order of severity of attack. Only recently this insect has been found in the wild haw and wild crab in Missouri. The damage done was found to be quite varied. In some orchards it was scarcely noticeable, while in others as much as 25 per

cent of the picked fruit was found to be infested. It is quite possible that this insect has gone from the wild haw (Cratagus) to the apple. In the Waverly district practically all the wild haws were cut out two years ago. The insect was not noted in apples before this time. Again it may be possible that it is of foreign origin, and the object of determining, at this time, the limits of its distribution in Missouri, is to enable the Plant Division to take any action which may be necessary when the species is definitely determined.

Two other very closely related services may be mentioned: The one is the correspondence service open to any one desiring information concerning any diseases or insects. The other is the issuance of short articles from time to time in various rural editions, giving seasonal hints for the control of some pest of horticultural or agricultural products.

The present organization, even though of only a few months existence, has received commendable co-operation and expressions of approval from the commercial nurserymen and fruit growers of the State.

DR. T. J. HEADLEE: Does this insect infest the fruit in such a way that it can be transported with the shipments of fruit?

MR. B. F. BOILLOT: Yes, it does.

CHAIRMAN WALLACE: The next paper is by L. M. Hutchins.

THE PHONY DISEASE OF THE PEACH

By LEE M. HUTCHINS, *Pathologist, U. S. Peach Disease Field Laboratory, Fort Valley, Ga.*

The first recorded observation of the disorder in peach trees now known as the phony disease was made in the Rumph orchards at Marshallville, Ga., a little more than forty years ago. Only a few trees were then affected and because of their small size in comparison with normal trees of the same age they were at first called "ponies." As the phony trees did not rapidly increase in number they were not at first viewed with alarm. However, they began to be more prevalent and by 1900 an occasional phony tree was seen in the peach districts near Marshallville and Fort Valley. Not until 1915 was the situation regarded as possibly becoming serious, and in that year the late J. H. Hale, whose Fort Valley orchards then numbered 100,000 trees, requested aid from the United States Department of Agriculture. By this time the phony condition in the trees had come to be regarded as a disease and the name "phony disease" had been applied. As a result of Mr. Hale's request, M. B. Waite, Pathologist in Charge of Fruit Disease Investigations, of

the Bureau of Plant Industry, spent several days that summer in the vicinity of Fort Valley studying the disease and making observation- of a general character. Himself a grower on a large commercial scale, and with wide experience in the study of both contagious and physios logical diseases of plants, Dr. Waite was at once aware of the possible menace that this new trouble, which had risen from obscurity to mention- able importance within a few years, might eventually constitute to the peach industry. He previsioned an eradication campaign and at the close of his visit recommended that the orchardists destroy all phony trees as fast as found. Specimen phony trees were dug up and sent to Washington for examination, and the writer, then an assistant in Dr. Waite's laboratory, made cultural tests from the material in an en- deavor to find a causal parasitic organism. The same season (1915) Dr. Waite budded normal peach trees with buds from phony trees as a test of communicability. Both the laboratory tests and the field tests gave negative results and it was then realized that a thorough-going series of scientific experiments would be necessary in order to determine the cause of the phony disease.

In 1915 losses due to the disease were only beginning to be felt even in the older orchards. Profits were large in those years and it was natural that the growers should more or less ignore this bizarre new-comer which appeared to actually improve the vigor of the trees it attacked. Few of the growers, indeed, believed it to be a disease, but considered it in the category of a sport, a degeneration of stock, or an overdose of nitrogenous fertilizer; to foresee the great havoc that it was destined to work was of course impossible. The situation was not regarded as a community problem and no concerted effort was then taken to bring it under control. From that time on, however, the disease increased at an alarming rate. Its mounting importance was obscured during 1919 and several succeeding years by a severe outbreak of curculio and brown rot, which caused great wastage of fruit in the orchards, sheds, in transit and at the terminals. Also the peach industry had developed to such an extent that there was a surplus of fruit, and heavy grading-out of the small phony peaches was not as significant as it would otherwise have been. Unfortunately, large quantities of phony fruit found its way to the markets and its effect was reflected in lower prices for the better grades. Conditions improved as far as the curculio and brown rot were concerned, but the inroads of the phony disease came on apace. The dark-green, bushy, phony trees appeared in ever-increasing numbers. The territory of its distribution broadened constantly. New orchards

began to exhibit phony trees, and new counties were invaded. The growers were soon to recognize the importance and subtle work of this most peculiar disease which does not kill, which for a time appears even to stimulate the tree, but which permanently impairs its function of fruit production.

In 1921, with the relocation of a Field Laboratory at Fort Valley for the study of fruit diseases, Dr. Waite incorporated researches on the phony disease as a special project and the writer was assigned to the work as a part of his regular duties. A brief examination made it evident that the cause could not be attributed to an easily discovered parasite. With a long history of peach yellows, rosette, and little peach behind us, one of the obvious experiments was to bud from phony trees to normal trees in order to determine whether the disease might be caused by a germ or virus that was carried in the bud. The latter procedure never fails to transmit any of the above mentioned diseases and a thorough trial was made in the case of the phony disease. Also, the first summer extensive orchard maps were begun in which the occurrence of all phony trees was noted and all new cases were recorded as soon as the characters could be definitely identified. Work was continued along these lines for several seasons and extensive data were taken on the characters of the disease in all parts of the tree at different seasons of the year. None of the budding experiments transmitted the disease and we had failed to open the subject up in any satisfactory manner. Phony trees that had been transplanted remained phony, seeds from phony fruit produced seedlings that were normal in every respect. When phony trees were dug up and replants were put in their places, the replants remained normal except for a certain number, corresponding with the usual incidence for new cases of the disease in the orchard in question. Normal nursery trees planted under the branches of phony trees contracted the disease when their roots were grafted to the roots of the phony tree, but when the graft connection was not made, the nursery trees grew normally except for the few that contracted the disease in the natural way. When the roots of a phony tree were in contact with the roots of a normal tree, the disease was in no case transmitted unless a graft union was made and the two roots were actually united by a growth process. It was thus evident that the disease is not usually, if ever, communicated through the medium of the soil. Nematodes, mycorrhiza and other microscopic soil organisms would appear to be eliminated as possible carriers. Furthermore, extensive surveys show that the disease in Georgia occurs in trees on all soil types and on all

sites. It has been found abundant on washed mountain sides and in fertile valleys, on land newly cleared from the forest and on old cultivated fields.

Orchard surveys seemed to indicate that under the most favorable conditions for its appearance a very small percentage of trees did not take the phony disease. When scions or buds were taken from these "resistant" trees and top-worked on phony trees the new shoots that put out were always typical of the disease. This latter behavior was true of scions of other species closely related to the peach, such as almond, apricot and nectarine. On the other hand, when buds or scions from phony trees were top-worked on normal trees the resulting growth was always normal. These and other experiments made it clear that if the supposedly resistant trees were really immune it must be due to a root character and not to any resistance of the shoot, or part of the tree above ground. It was evident that the disease is attributable to a root condition.

In January, 1926, experiments were begun in which pieces of phony roots were grafted to the roots of normal trees in the orchard and in the nursery, and a large number of piece-root grafts were made. The summer of 1926 brought no results. Similar experiments were carried on in January and February, 1927, on a more extensive scale. In August, 1927, a number of orchard trees that had been grafted with roots from phony trees in January 1926, showed unmistakable signs of the phony disease. More evidence was desired in order to draw definite conclusions. In the summer of 1928 results were recorded from experiments performed in January, 1927. These results showed unmistakably that wherever phony roots were used in making piece-root grafts or in grafting on root systems of normal orchard trees, the experimental trees developed typical symptoms of phony disease. The incubation period, or interval between the time the inoculation was performed by the grafting method and the time that the experimental plants showed very definite phony characters, was approximately eighteen months in all of these experiments. All of the check experiments in which normal roots were used remained normal.

At this time it became evident that the phony disease is contagious. Inoculations with the juice expressed from the roots or other parts of phony trees have not communicated the disease under the conditions of our experiments. It has thus far been artificially communicated only by means of grafting a phony root to the root system of the normal tree. This behavior places the disease in the peach yellows group, and

Normal peach tree, Hiley variety, at end of third year's growth in the orchard

Phony peach tree, Hiley variety, at end of third year's growth in the orchard. This tree has just come down with the disease

Hiley peaches. Left, fruits from a normal tree. Right, fruit from a phony tree

the infective principle is now regarded as a virus. However, the phony disease differs from peach yellows in that the virus of phony disease has been found only in the roots of diseased trees and does not appear to enter the shoots above the soil line, while the peach yellows virus invades both shoot and root. This explains why the phony disease is not communicated when buds, scions or seeds from diseased trees are employed.

The phony disease has been wrongly called "collar oedema," the latter term being the name of a physiological disease of peach trees caused by low temperatures that injure but do not kill the tissues about the collar of the tree, the injured growth then swelling and abnormally increasing the diameter of the tree at that point. The word phony is defined "bogus, counterfeit, false." There is no authority for the spelling phoney, as sometimes occurs. The history of the origin and first application of the term "phony disease" is not known, but the disorder was called to the attention of the Department by that name in 1915 and has since come into general use as the official name of the disease.

When plants or animals are diseased, we customarily find the entire individual or parts of the individual showing definite pathological symptoms. The phony disease of the peach presents a remarkable exception to this general rule in that phony trees may have deeper green foliage than normal trees and may in many instances be said to present a healthier appearance. This most unusual character has led to the disease being ignored in small home orchards, in abandoned lots, along road sides and even in commercial orchards where the disease has recently appeared and growers are unfamiliar with it. Until recently growers have not regarded the disease as contagious and have generally given no serious thought to it as a possible menace to the peach industry.

Initial characters of the phony disease do not appear in commercial plantings before the latter part of the second growing season in the orchard, or three seasons from the bud. Thereafter, trees may come down with the disease at any age, and the first symptoms may become evident at any time between May 1 and September 15 of the year that the disease develops.

With the onset of the disease a phony tree develops shortened internodes, a large number of lateral twigs, and large, flattened, dark-green leaves, giving the appearance of compact, dense growth with very healthy foliage. Especially in young trees, decided dwarfing results, and

normal trees quickly exceed phony trees in circumference and height. The annual terminal twig growth of a phony tree may be only from one to six inches, as compared with a terminal growth of one to three feet or more in normal trees. The phony condition may advance the blooming, leafing, and fruit-ripening dates a few days, and it may retard the time of autumn leaf fall. In advanced cases, phony trees may be identified in the dormant condition by the short terminal and the profuse, short, lateral twig growth. In such trees, because of the condensed appearance of the growth, the disease is usually evident at blossoming time and with the first mature leaves in the spring.

Phony trees do not seem to be more subject to winter injuries than are normal trees, and they may live many years after showing the symptoms of the disease. However, since the terminal growth is short, it is difficult to shape the phony trees by pruning to stimulate new growth, and as large limbs die they are not replaced by the tree. After four or five years of the disease the trees are generally ragged and there is apt to be a marked dying back of terminal twigs and branches.

From the first observations of the phony disease at Marshallville, Ga., the disease has spread until at the present time it covers practically all of the commercial peach industry in Georgia and has extended into parts of Alabama and Mississippi. So far as is known this is the only section in the world where the disease occurs. Correspondence and observations in various peach districts of the United States have failed to show any other centers of infection in this country and we are unable to learn of anything like it in other countries. In its area the disease is much less severe in the peach districts at a distance from the locality where it was first found.

The control of the phony disease is now being directed under three distinct classifications. At the Research Laboratory at Fort Valley a study is being made of the various root stocks adapted to top-working to peach, in the hope of finding a good commercial stock that is resistant to the phony disease or its natural carrier.

The United States Department of Agriculture is co-operating with the Georgia State Board of Entomology and the Alabama State Department of Agriculture in an eradication campaign to eliminate the diseased trees from the entire area where it occurs. The campaign is under the general direction of K. F. Kellerman, Associate Chief of the Bureau of Plant Industry, Washington, D. C. William F. Turner is in charge of the eradication work in the field, with headquarters at the U. S. Peach Disease Field Laboratory, Fort Valley, Ga. In the co-operative project,

Manning S. Yeomans, Georgia State Entomologist, and B. P. Livingston, Chief, Division of Plant Industry, of Alabama, represent their respective states. The past summer Mr. Turner had a force of six squads consisting of five men each who visited commercial orchards and either cut down or tagged the phony trees for removal. Mr. Turner states that his force has covered over three-fourths of the commercial trees in Georgia and Alabama and that in September his men inspected approximately five hundred thousand commercial trees per week. The inspectors for this work are selected for general training, experience and adaptability to the work and are given a course of instruction at the U. S. Peach Disease Field Laboratory, Fort Valley, Ga., in which they become familiar with the characters of the disease and its identification in the field in trees of various ages and varieties.

Another feature of the control of the phony disease is Federal Plant Quarantine No. 67, effective June 1, 1929. Under the provisions of this quarantine, shipments of peach nursery trees from the phony disease territory to a territory where the disease does not occur is prohibited when phony trees are known to occur within a distance of one mile of the nurseries.

(For complete information on the quarantine, communicate with Plant Quarantine and Control Administration, United States Department of Agriculture, Washington, D. C.)

It is an established fact that the phony disease is communicable in nature by some means not yet understood and that nursery trees in close proximity to phony trees may contract the disease. As the incubation period of the phony disease is about eighteen months (under the conditions of our experiments), the root system of the nursery tree may become diseased without it being possible to identify the disease in the top growth before shipping time. It is thus possible to disseminate the phony disease by means of nursery stock and for that reason the quarantine is applied. The quarantine does not apply to movement of nursery trees within a quarantined area; that is, a nurseryman even though phony trees may be found within a mile of his nursery may still be permitted to ship his trees to points within the area.

The loss to the peach grower, from the phony disease, consists in fewer fruits from the phony trees and in a decrease in the size of such fruits. The first year that the disease appears in the tops of the trees there is a notable reduction in the average size of the fruit though the number of fruits may not be affected because the fruiting wood was grown in an apparently normal way the year before. With each suc-

ceeding year of the disease in a tree, the crop may become smaller and the average size of the fruit is apt to be smaller until after three or four years of the disease there may be no marketable peaches from the phony trees. Such trees are therefore a liability to the grower as he has the expense of all orchard care and of the occupation of the land, for a non-productive tree. In the territory where the disease was first observed, orchards are on our records in which 99 per cent of the trees were phony at twelve years old. In one case 60 per cent of the trees were phony in an orchard four years old. These young trees were near older orchards in which the percentage of phony trees was large.

It should be remembered that the phony disease cannot be spread by means of phony fruit, seeds, buds or scions. Shipments of fruit containing phony peaches in no way endanger the peach industry of communities through which such shipments may pass or be consumed. No discrimination against peaches from the phony disease area is justifiable, therefore, on the basis that they might possibly introduce or disseminate the phony disease.

Under no conditions has a phony tree ever been observed to recover from the disease. However, the disease does not kill the tree that it attacks. Trees are on our records that have exhibited phony characters for the past eight years and are still living. Roots from these same trees have never failed to communicate the disease to normal trees in root grafting experiments. The longevity of the phony trees, therefore, constitutes a serious problem in the eradication of the disease. Phony door-yard trees may year after year introduce the disease anew into nearby commercial orchards, even though the orchardist himself may practice thorough eradication.

The present well-organized eradication campaign aims, therefore, at biological eradication of the phony disease as the only sure means now known for bringing it under control and preventing an equally disastrous recurrence at some time in the future.

CHAIRMAN WALLACE: Our next paper, and the last one, is by E. N. Cory.

PRACTICABILITY OF THE HOT WATER TREATMENT FOR THE BOXWOOD LEAF MINER[1]

By ERNEST N. CORY and C. GRAHAM, *College Park, Maryland*

ABSTRACT

The practicability of spring treatment of four varieties of the genus Buxus, using hot water at 120° F. for five minutes, has been demonstrated by the treating of 2,430 plants, ranging in size from one to three feet. There was slight temporary injury to tender foliage. The cost, including equipment, was near eight cents per plant.

The boxwood leaf miner has become a pest in a number of states and has been declared, by the Eastern Plant Board, as one of the insects that should be prevented from moving interstate and, therefore, it becomes necessary for regulatory officials to provide a means whereby the infested plants can be successfully treated at a cost that permits the general use of the treatment. Several methods have been used that are fairly successful for the treatment of plants on estates, but are not efficient enough to warrant dependence upon them for purposes of certification of the plants for interstate movement. A method of treatment, using hot water, was worked out by Dr. F. F. Smith of Pennsylvania and details in regard to the method were furnished to the present writers by both Messrs. Smith and Trimble, the latter of the Pennsylvania Department of Agriculture. This method was tried out on rather a large scale in order to determine its effectiveness and its practicability. Fall treatments have not yet been checked.

Nine hundred and thirty heavily infested plants, ranging in size from two to three feet in height, were treated at one nursery and fifteen hundred plants, ranging from one to three feet in height, were treated at another nursery. These were mostly of the variety *Buxus sempervirens*, although some of *B. suffruticosa*, *B. arborescens*, and *B. rotundifolia* were included at one nursery. The conditions in the two nurseries were different, one place being equipped with boilers used for heating the greenhouses, and the other having no such equipment. In fact, the methods used at the two places were slightly different and will be described separately.

At nursery Number 1, five large barrels were placed in a boiler room and temporary hose connections for steam and water run to the barrels. A temperature of 120° F. was maintained without difficulty by stirring the water and running in extra steam from time to time as the thermometer showed a dropping of the temperature. The plants were

[1] *Monarthropalpus buxi* Labou.

brought into the room, inverted in the barrels, and held in place by two 2 x 4 strips. In this way, two to three plants could be suspended in each barrel and seventy-five to one hundred plants could be treated in this way per hour. It was found that it was impractical to burlap the roots, because of the great probability that some twigs would be covered by the burlap and in that way kept out of the hot water. The plants were treated about the middle of April and re-set on the same day that they were treated. Examination one month after for the presence of live larvae failed to show any, and showed the plants for the most part to be in excellent condition. Some tender tips had been killed, but a second inspection in October showed that the plants had survived the treatment and put out new growth. At the same time, an examination was made, plant by plant, for evidences of new injury, but no trace of the midge could be found except the old mined leaves with dead larvae within.

COST OF TREATMENT AT NURSERY NUMBER 1

Number of plants treated	930	
Number of days required for treatment	2	
Number of men per day	7	
Cost of labor		$65.00
Cost of truck		10.00
Total cost of treatment (exclusive of equipment)		75.00
Cost per plant		0.077

At nursery Number 2, since there was no equipment available, the owner purchased a second-hand portable steam engine for $40.00 and with this he heated the water in a trough, which he made himself. This trough was three feet deep, four feet wide, and six feet long. Over the top, strips of 2 x 4 were placed lengthwise and by this means as high as thirty plants could be inverted in the hot water at a single time. These were then loaded on a wagon, at the end of the five minute treatment period, and returned to the field for planting. By this system two hundred and fifty to three hundred plants could be treated per hour. No difficulty was experienced in keeping the water temperature within one degree of the desired 120°.

The treatment was begun on April 24 and the first inspection was made on May 20 for the presence of live larvae and for injury to plants. Apparently no live larvae were present at this inspection and injury to the plants was slight except in one or two cases where the plants had slipped into the tank and were submerged for more than five minutes. Plants were again examined in October for evidence of new injury from the leaf miner, but no such injury was found. The plants had recovered from the treatment and transplanting and were growing well.

COST OF TREATMENT AT NURSERY NUMBER 2

Number of plants treated	1500	
Number of days required for treatment	4	
Number of men per day	4	
Cost of labor		$ 40.00
Cost of horse and wagon		12.00
Cost of boiler		40.00
Cost of trough		25.00
Total cost of treatment		117.00
Cost per plant		0.078

Plants should be treated on a cool or cloudy day or else should be protected from the sun until late in the afternoon before being transplanted to the permanent location.

SUMMARIZED DATA

Total number of plants treated	2,430	
Total cost of treatment including digging and transplanting, but not including permanent equipment		$127.00
Cost per plant		0.052

SUMMARY

The practicability of spring treatment of four varieties of the genus Buxus, using hot water at 120° F. for five minutes, has been demonstrated by the treating of 2,430 plants, ranging in size from one to three feet. Slight temporary injury to tender foliage, but no permanent injury resulted on any of the plants treated correctly. Either temporary equipment, using barrels heated by greenhouse boilers, or the construction of a permanent vat heated from a portable boiler, is satisfactory, and the latter does not increase the cost beyond reason.

CHAIRMAN WALLACE: Next is the report of the National Plant Board. Dr. W. C. O'Kane will present this report.

DR. W. C. O'KANE: The National Plant Board report will be as brief as I know how to make it. At the last minute, Mr. McCubbin couldn't be here, and he asked me to report in his place. As you see, I am reporting informally.

I think the National Plant Board is now in its fifth year. It has grown following the growth of some of the constituent boards. The first of the four regional plants was the Western Plant Quarantine Board. I believe that was organized about 1918. Then the Eastern Plant Board, the Central, and the Southern followed.

The status of the National Plant Board is, of course, not that of a body with authority. The status must be understood. It cannot have any possible authority over the regional boards nor over the constituent states, nor can a regional board have real legal authority over its con-

stituent states. Under the organization of the states under the United States constitution that is impossible, but the situation which has arisen in this country in the last ten or fifteen years from the discovery of plant pests in which federal agencies are interested, and in which, also, state agencies are interested has necessitated some form of joint organization. The federal agency, of course, is thoroughly organized. The state agencies cannot be organically brought together. They can be brought together only through some type of voluntary organization in which a board or committee or commission is set up that acts as a sort of spokesman for the several states. That is the ultimate object of the National Plant Board.

As you know, this whole country is divided into four regions, each of which has its regional board. The membership of these boards is drawn from the several states comprising that region, and each of the four regional boards selects two men. Those eight men constitute the National Plant Board. So the National Board, then, stands as spokesman for the states and for the regional boards. That makes possible a sort of highly desirable correlation of understanding between the federal agency and the states.

The need for that correlation is arising continually, and in increasing degree. Those who have been serving on the National Plant Board since it started have seen that continually grow, and it will grow in the future. A given situation arises, a pest appears; control, possible extermination, quarantine measures, and so on, are given consideration. Any of these might be undertaken by federal authorities, or they might be undertaken by state authorities. For a long while we had conflict of those two, or overlapping, or measures that did not fully harmonize. That was natural. One or the other of those two groups, either the federal department or the state concerned, has to handle the situation, or the two work together.

Through the regional boards, and through the National Plant Board, cooperation of that kind, a harmonizing of measures becomes possible. So, during the last four years there have been joint meetings of the National Board with the Plant Quarantine and Control Administration to discuss matters in which both are interested. They wanted to come to an understanding, the final outcome of which either was that the Federal Board would undertake certain measures with reference to a new situation, such as an insect outbreak, or that it would leave the matter to the states. That decision followed discussion between the state men on the one hand, and the federal men on the other.

Personally, I think the possibilities in the future for helpful action on the part of the National Plant Board, as representing the regional boards, is very great. There cannot be too many agencies backing the Florida campaign at the present time.

Not so very long ago I happened to stop in at the office of Chairman Haugen of this state in Washington. In the course of conversation he said to me, "Between us, is there anything to this Mediterranean fruit fly situation?" That was not this fall. That was last spring, but it was after the outbreak had become well recognized, and after the big campaign had started. The reason he asked was because a man of national significance had been in talking to Chairman Haugen and had said, "Well, they have had that thing down there for many years. It is simply a temporary affair, and it will all peter out." I don't mean to say that Chairman Haugen believed that, but at any rate he put that question to me. "Give me the straight on it; does it amount to anything? Give me the lowdown."

You will be certain to find that about everything that arises, and we, ourselves, exhibit the same skepticism about that which we don't know, time and again.

One of the things that the National Plant Board can do is to help to back up federal programs and state programs, and if it accomplishes that it will have accomplished a lot. I look to see that happen more in the future.

The National Board, unfortunately, has lost its valued Chairman, Lee Strong. We had to give him up to be the Chairman of the Federal Board. We are hard up without him. We think theNational Administration is darned lucky to have him.

That is about the only report there is to be made at this time. I merely bespeak your cooperation as individuals, as state individuals, with the National Board and regional boards. None of us can tell what it will accomplish in the future, but I think it can accomplish a lot. (Applause)

CHAIRMAN WALLACE: Next will the reports of Regional Boards. First is the Eastern Plant Board, T. J. Headlee, Chairman. Dr. Headlee is not here just now. We will take the Southern Plant Board, G. M. Bentley.

REPORT OF THE SOUTHERN PLANT BOARD

By G. M. BENTLEY, *Chairman, Knoxville, Tenn.*

The regular meeting of the Southern Plant Board was held at Houston, Texas, Feb. 5, 1929, Prof. R. W. Harned, A. & M. College, Miss., Chairman, W. E. Ander-

son, Baton Rouge, La., vice-chairman; B. P. Livingston, Montgomery, Ala., secretary. Representatives on National Plant Board Dr. Wilmon Newell, Gainesville, Fla. and Mr. R. E. McDonald, Austin, Texas.

The meeting was called to order at the Rice Hotel, Houston, by Chairman R. W. Harned and the following program was rendered:

1. *Roll call by States* showed representatives from the following States: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas. North Carolina and Tennessee were not represented. There were also representatives from Arizona and Maryland as well as the Federal Government and the (Texas) State Experiment Station.
2. *Reports of standing committees* were heard.
3. A report was given by the representatives on the National Plant Board.
4. Reading of papers and general discussions of:
   (a) Mexican fruit fly.
   (b) Pink boll worm.
   (c) Argentine ant.
   (d) Sweet potato weevil.
   (e) Sweet potato certification.
   (f) Parcel Post inspection.
   (g) Port inspection.

Mr. P. A. Hoidale, of the Plant Quarantine and Control Administration, Atlanta, Ga., had a splendid paper giving quarantine safeguards being taken on the Texas border in regard to the Mexican Fruit Fly. This paper being of general interest to all southern entomologists it was decided to give this paper the following day before the meeting of the Cotton States Entomologists. This paper is published in the JOURNAL. Mr. B. R. Coad's paper on the Pink boll worm was also held for the entomologists' meeting the following day and is also published in the JOURNAL.

The Argentine ant was discussed by Prof. R. W. Harned. At the close of this discussion a resolution was passed urging the Federal Government to take up the matter of eradication. This resolution was adopted by the Southern Plant Board.

The subject of the Sweet Potato Weevil was assigned to Mr. Tom O'Neill, Austin, Texas, of the State Dept. of Agriculture of Texas.

His paper "Sweet Potato Certification" was discussed in connection with the previous papers by B. P. Livingston, R. W. Harned and M. S. Yeomans.

The Parcel Post Inspection was a subject of much interest and the chief speaker was the Post Master at Houston. He stressed co-operation in the work by the postal authorities and the plant inspection officials. A resolution was offered to have the plant products in parcel post shipments sent immediately to inspectors without waiting for the extra postage, which had meant a considerable delay.

The subject of Port Inspection was entertainingly handled by Oscar Bartlett, of the Arizona State Dept. of Agriculture also by a deputy on border inspection at Hildalgo, Texas. Both of these discussions had special reference to the Border inspection between Mexico and Texas.

At the executive session of the Board G. M. Bentley, Knoxville, Tenn., was elected chairman, B. P. Livingston, Montgomery, Ala., secretary and Prof. R. W. Harned, A. & M. College, Miss., as a representative of National Plant Board for two years.

A special meeting of the Southern Plant Board was held at Atlanta, Ga., May 13th. This meeting was devoted entirely to discussing the Mediterranean Fruit Fly.

Representatives of all the Southern states were present as well as Dr. C. L. Marlatt, P. A. Hoidale and Mr. Kastal of the Plant Quarantine and Control Administration. Dr. C. L. Marlatt gave a detailed account of the fly situation as known at that time, its discovery in Florida having been made April 6th. The precautions to be taken by State officials were emphasized. Methods of examining for the larvae were explained. This was a most instructive meeting at the close of which arrangements were made with state representatives for immediate steps to be taken in their respective States.

Letters to Congressmen have been sent by all the members to their members in Congress in regard to appropriations for the Mediterranean Fruit Fly.

Dr. Wilmon Newell's resignation to the National Plant Board has been presented by himself and to fill his unexpired term Dr. R. W. Leiby, Raleigh, N. C., has been appointed.

The next regular meeting of the Southern Plant Board is set for February 5, 1930, at Jackson, Miss.

CHAIRMAN WALLACE: We should like to have the report of the Central Plant Board, Mr. P. A. Glenn.

REPORT OF THE ANNUAL MEETING OF THE CENTRAL PLANT BOARD FOR THE YEAR ENDING, MARCH, 1929

The fifth annual meeting of the Central Plant Board was held at East Lansing, Michigan, March 1st and 2nd, 1929, with the following States represented: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio and Wisconsin. The States not represented were Kentucky, North Dakota, and South Dakota.

The most important subject that came up for discussion was the statement of Principles of Quarantine submitted for the action of the Central Plant Board by the National Plant Board through Mr. Geo. A. Dean. The statement of principles was approved, and was considered a valuable piece of constructive work accomplished by the National Plant Board along the line which the National Board is expected to function.

With reference to the entry into this country of commercial shipments of onions infested with the lesser bulb fly, members of the Central Plant Board expressed the opinion that so long as the Plant Quarantine and Control Administration required the treatment of narcissus bulbs infested with the lesser narcissus bulb fly as a condition of interstate movement, it ought not permit the entry into the United States of commercial shipments of onions infested with this pest without treatment. A motion asking the Plant Quarantine and Control Administration to exclude infested onions prevailed.

An interesting and instructive demonstration of the inspection of gladiolus was conducted by Mr. Harry F. Dietz.

The Board discussed the road quarantine for the European Corn Borer and it was the consensus of opinion that the road quarantine should be continued.

The Board was favored by having present Mr. Geo. I. Reeves, who gave an instructive illustrated talk on the alfalfa weevil problem.

We were also favored by Mr. S. B. Fracker who explained methods of conducting transit inspections of plant products passing through the mails, by express and freight.

The officers of the Board were reelected for another year. They are as follows: President, Frank N. Wallace; Secretary-Treasurer, P. A. Glenn; Members of the National Plant Board—Mr. Geo. A. Dean, 1928–1931, Mr. A. G. Ruggles, 1928–1930.

CHAIRMAN WALLACE: We will next hear the report of the Western Plant Quarantine Board to be given by Mr. A. C. Fleury.

REPORT FOR THE WESTERN PLANT QUARANTINE BOARD—1929

By W. C. JACOBSEN, *Secretary State Department of Agriculture, Sacramento, California*

INTRODUCTORY

Consideration of the difficulties attending enforcement never seem to be lacking whenever a group of plant quarantine officials meet. In the main, these difficulties seem to arise from a lack of information on the part of the general public or on the part of agents of transportation companies not fully familiar with the purposes and value of quarantine in stemming pest invasion, nor with the heavy expense which can be levied on an agricultural industry to control pests. Sometimes it is because of indifference, or frequently because there is some inconvenience attached to the observance of quarantine requirements. Inconvenience, of course, is a necessary evil in connection with all law enforcement work, and the patience of the average Mr. Citizen does not incline to very great tolerance when the inconvenience is caused because of a danger from bugs. His conception of the effects of serious pests in everyday business is not very active.

However, do we not, as quarantine enforcement officers, endeavor to carry more than is necessary of the burden of defending some of the things that we are charged with a responsibility of doing? The protection against pest losses afforded the agricultural industry, and indirectly to other business, by quarantine enactments and their enforcement is too frequently misunderstood even by the people to whom they are of greatest value. Perhaps we could sponsor a more intensive attempt at educational work to give them a broader insight into the purposes and value of plant quarantine and nursery inspection and make them parties to many of the discussions which, at the present time, are confined almost exclusively to officials. Growers and farmers could be made to feel that they are real participants in consideration of measures relative to pest prevention. Our experience in the Western Plant Quarantine Board has been, that whenever they have participated each has turned out to be a missionary preaching the gospel of adequate inspection and proper quarantine enforcement, frequently in a better fashion than those technically engaged in the work. In California we have a great number of farmers who are fully "quarantine conscious," if that be a proper term.

Early in the history of our Western Board, the transportation agencies were made an integral party of our organization, and as a result there has been not only full understanding of the importance of quarantine but a spirit of cooperation developed which has stood us in excellent stead many times. Therefore, wherever possible, growers and trasportation representatives should be invited to attend quarantine and inspection conferences and every opportunity taken to present more detailed information as to our purpose regardless of whether or not they might be directly concerned at the time. Sooner or later every farmer feels the effects of agricultural regulatory work, of which plant quarantine is a highly important part.

Some do attend now with special requests, either to have a particular burden relieved or to attempt to gain an advantage, but these are purely incidental to our thought here. Such people frequently develop a changed viewpoint and generally obtain a far better understanding of quarantine whys and wherefores.

There is opposition occasioned by people who are inherently out of sympathy with quarantine enforcement, often conscientiously. They will hardly deny the importance or necessity of pest control, yet they completely overlook the fact that quarantine enforcement is a real phase of pest control being exercised as a prophylactic measure.

After all, quarantine is the primary phase of pest control, representing inspection vigilance and organization before pest establishment rather than after. Seldom can numbers of pests be dealt with so advantageously with the same organization as is the case with quarantine, and at a far less expense than actual field pest control campaigns against a single insect or disease after their establishment. The agricultural industry should be encouraged to really voice its sentiments. They would then understand that quarantine, as a primary pest control measure, is more advantageous than the individual burden of pest control expense. Growers' organizations should voice themselves to a far greater extent than they do in supporting plant quarantine, but they must learn of its precepts before this is possible and, undoubtedly, it is among our responsibilities to offer assistance in this connection. The trend toward making quarantine knowledge a matter of wider information does appear more evident in the Western Plant Quarantine Board.

Work of the Board

Most important of all matters coming to the attention of the Western Plant Quarantine Board was the finding of Mediterranean fruit fly within the United States. An informal meeting of the Board was held at Sacramento early in May, at which time the members present pledged their full support to the eradication program which had been undertaken, expressed full confidence in the leaders in that campaign, requested such action to be taken by the Plant Quarantine and Control Administration as would insure against spread of fruit fly into western and southern areas where host fruits of fruit fly were being grown under climatic conditions undoubtedly favorable to its establishment, and emphasized again the importance of additional federal quarantine inspection at maritime ports and at border points of entry.

As a result of this meeting, there was a co-ordinated opinion among the western states which was carried forward to the regular annual meeting of the Board at Salt Lake City, Utah, in July.

At that time the resolutions of the informal Sacramento meeting were reaffirmed, and, besides, the members pledged to aid in whatever ways possible to support requests for necessary finances to carry this campaign to a successful conclusion.

Especial consideration was given to the possibility of trans-shipment of host fruits of fruit fly from sections into which shipments might move directly from the quarantined area in Florida. This condition has since been greatly helped by the development of heat treatment and close supervision of certification of host fruit and vegetable shipments moving out of Florida.

It was agreed that it would be desirable for the western states to undertake, insofar as possible, more intensive surveys of the fruit and vegetable growing districts under their jurisdiction to determine if, by chance, any fruit fly infestation has become established from host fruits shipped in before the federal quarantine was in force.

This was coupled with the agreement that quarantine enforcement would be intensified insofar as possible under the limited funds and personnel available, and thus to encounter violations of federal quarantine No. 68.

Augmented finances for additional federal port and border inspection were again given serious consideration, and it was agreed to fully support all requests for this additional service when this subject came before Congress in connection with the budget for the Plant Quarantine and Control Administration, it being recognized that while a partial inspection is a helpful deterrent to the introduction of injurious pests and diseases, yet, until all ports and border points are fully covered, there will always be some appreciable hazard, especially at ports not guarded and through which an occasional lot of infested plant material might find its way.

Representation has been made to members of Congress by the individual members of the Board, not only in connection with this subject, but they have consistently kept before their members of Congress the importance of obtaining necessary finances with which to further support and carry on the Mediterranean fruit fly work.

Larch canker was considered a very potential menace to the vast acreages of valuable lumber timber, including Douglas fir and western yellow pine species, both of which seem to be susceptible. The U. S. Plant Quarantine and Control Administration was petitioned to take necessary additional steps to provide for adequate scouting of possible areas of larch canker infection, and to place in effect restrictions to prevent introduction into new areas. Reports from the office of Forest Pathology, U. S. Bureau of Plant Industry, indicate that all known infestations are being eradicated as rapidly as they are being found.

Certain matters were referred to the National Plant Board for consideration, especially to bring about the discontinuance of shipments from Argentina and Porto Rico of dangerous pest hosts to northern Atlantic sea-ports, because of the danger of their reshipment after arrival into states having crops susceptible to some of the pests they might carry.

The National Plant Board was requested to develop a sound publicity program for the purpose of disseminating fact-based information on the purposes of plant quarantine, diverting this information into journals of national and agricultural circulation to counteract the unfavorable consideration that is being given to items prepared by those opposing plant quarantines. Frequently, those who are in disagreement with plant quarantine have suggested an investigation of the effects of quarantine, the tenor of such suggestions indicating that quarantine is detrimental, whereas, actually a full investigation of the subject of plant quarantine would unquestionably reveal the reverse to be true. Proper information in magazines would help.

The National Plant Board was further requested to follow closely all developments in connection with the Mediterranean fruit fly campaign, especially insofar as modifications in federal quarantine No. 68 were concerned.

The special items for consideration and for which active committees were appointed or continued were as follows:

(1) Weed Control. It was recognized that some states do not conduct any systematic weed control investigations but that frequently when such investigations are being undertaken they are duplicated because of lack of knowledge of what is being carried on in other sections of the United States. Therefore, a request was made of the U. S. Department of Agriculture that it centralize all of its weed control investigations under one head or division so that there would be one point of contact

in Washington for all weed control information and thus give the several states an opportunity to cooperate under the leadership of one consistent federal organization. Now, it is necessary to contact a wide variety of bureaus and divisions, some of which were engaged in observations on weed control only in a limited field to meet their immediate needs. The ability of weeds to harbor pests over periods when crops are not in evidence or dormant and their capacity to serve as intermediate hosts of injurious insects and plant diseases, has led to more intensive consideration of the weed control problem.

(2) APIARY INSPECTION. The Western Plant Quarantine Board undertook as early as 1924 to give consideration to a uniform plan of handling apiary inspection quarantines and disease control measures as between the eleven western states. The net result over a period of years has been the appointment of a permanent apiary inspection committee with a project of work outlined. The primary considerations involved are the development of a reliable system of certification for movements of bees and apiary equipment as between states, also the adoption of burning as a method for American foul brood eradication.

(3) ALFALFA MEAL. One of the projects of major importance for the Western Plant Quarantine Board is an investigation as to the pest hazards involved in the movement of alfalfa meal from the angle of enhancing the spread of alfalfa weevil. This Board was responsible for and approved the investigations made a number of years ago which brought about quarantine modifications to permit the movement of alfalfa meal from alfalfa weevil infested territories during the winter season under proper safeguards. Further investigations were considered necessary to determine whether the movement of alfalfa meal the year around could be made safe.

The Board was responsible for obtaining $5000.00 for the U. S. Bureau of Entomology and resulting investigations by the Bureau Laboratory at Salt Lake City indicated that equipment between the sacking room in the alfalfa meal mill and the railroad car would be the essential to prevent any contamination of the meal after it had come through the milling process. The milling process itself proved satisfactory as a means of destroying any possible infestation.

The Alfalfa Meal Committee of the Western Plant Quarantine Board has had several informal conferences, one as recent as September 10, 1929, at which time they approved plans for a mechanical device for guarding against contamination at car door. These plans have been submitted to all of the member states and now await their ratification before adoption. If approved, steps will then be taken to modify the quarantine regulations of the several states in order to permit movement of meal the year around.

GENERAL MATTERS

Ever since it became apparent that funds for continuing the eradication campaign against Mediterranean fruit fly were running low, the members of the Western Plant Quarantine Board have consistently sought the aid of our Congressmen in supporting adequate appropriations to carry this work on to a successful conclusion. The results obtained in Florida, under the direction of the Plant Quarantine and Control Administration and Dr. Wilmon Newell, have been such that there is every hope that eradication can be accomplished. The necessities therefor indicate that unless adequate finances are available, much valuable work will have to be discontinued and the accomplishments to date will receive a serious setback. Every state in the

United States should lend their support to this project regardless of their crops. Other serious pests may find an entrance into their territory.

Three states of the Western Plant Quarantine Board recently attended the 52d Fruit Growers and Farmers Convention at Sacramento in December, 1929, at which time they were interested participants in consideration of matters pertaining to adequate support of plant quarantine and in connection with matters having to do with the Mediterranean fruit fly campaign. The member states of the Western Plant Quarantine Board have, ever since its organization, worked in the closest harmony. There have been occasional disagreements as to policies and procedure but these have been ironed out with proper satisfaction when submitted in conference.

CHAIRMAN WALLACE: We will have the report of the Eastern Plant Board by Professor T. J. Headlee.

REPORT OF THE EASTERN PLANT BOARD FOR THE YEAR 1929

During the year 1929 the operation of various plant quarantines of inter-state and intra-state character has claimed most of the attention of the Eastern Plant Board. This statement does not mean that the board has lost interest in the problem of simplifying and improving the operation of ordinary plant infesting insect control activities, but rather that plant quarantine matters have forced themselves into the foreground by the effect they are having upon legitimate business interests.

Speaking in general it has seemed to us that quarantines have laid a heavy charge upon our people for the benefit of other portions of the United States, in spite of the fact our people are in no wise to blame for the appearance of certain insects in our territory first. With present practice, this charge is paid by individuals, firms, and corporations, which at the same time are also called upon to contribute their share of federal taxes. Furthermore, the people of each state are taxed to contribute state money to the operation of certain of these quarantines. It should be pointed that the individual, firms, or corporations doing a plant business may and sometimes is compelled to finance certain operations of his or its business solely to conform to quarantine requirements, to pay taxes to the state part of which is used to operate the to him decidedly injurious quarantine, and to pay taxes to the federal government part of which is also used to operate the to him injurious quarantine.

The American business man is really extraordinarily patient in the face of such conditions as outlined above and so long as he can conform and keep his business going he will do so with a minimum amount of grumbling, but where the restrictive measures reach a point where he can foresee not only sharp curtailment of his business but its quite possible destruction, his reaction is bound to be as vigorous as he can make it and he is certain to carry it too far if his efforts meet with success.

The Eastern Plant Board has been brought into sharp contact with the business man's reaction to certain plant quarantines now in force in the eastern district and has been made to feel that they constitute a very real problem, a fair and equitable solution for which is urgently needed. Of course, the prominence of this problem is not a matter of one year's growth nor is the board's knowledge of it a matter of very recent occurrence. The year 1929 simply represents the highest point as yet reached by the reactions. That point has, however, been sufficiently high to force itself into the foreground of the Board's thought.

The Eastern Plant Board has adopted the statement of quarantine principles, submitted to it by the National Plant Board, with only very minor changes, because it felt that this statement represented a fundamental step in the right direction. Drawing upon its first hand experience with plant quarantines it adopted the following resolution at its last annual meeting.

"When an insect, new to or not heretofore widely distributed within the United States, has become established immediate investigation and suppressive measures should be prosecuted vigorously, coupled with such practicable quarantine measures as offer the best hope for the prevention of spread."

"If and when it has been determined that the pest has not been eradicated or suppressed and has been further distributed, the principal efforts of the responsible Federal and state officials should be directed towards research designed to develop the most effective control measures. Coupled with the research program, quarantine measures designed to guard against the establishment at long distances from the original locus should be the principal or only effort at regulation."

This resolution is designed to reduce quarantine procedure to the minimum which will afford all the really practicable protection and to emphasize the need for immediate, constant, and swift research to form an adequate basis for each necessary restrictive step.

It was thought that the more basic matters were covered by the statement of quarantine principles above referred to.

It is felt by the Eastern Plant Board that plant quarantine matters have reached a point in the eastern district where they constitute a distinct and dangerous problem, a satisfactory solution for which is most urgently needed. Up to the present time this board has taken no formal action, other than adopting the statement of quarantine principles and the passage, of certain resolutions, the chief of which has been quoted in this report, looking toward the solution of this problem.

CHAIRMAN WALLACE: We will next have the report of the Resolutions Committee.

REPORT OF THE COMMITTEE ON RESOLUTIONS, SECTION OF PLANT QUARANTINE AND INSPECTION, AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

WHEREAS: The eradication of the Mediterranean Fruit Fly is of paramount importance to the southern and western fruit and vegetable producing sections of the United States, as well as the consuming public of the entire United States and Canada, and

WHEREAS: The eradication campaign so efficiently and successfully iuagurated and conducted by the state of Florida and the United States Department of Agriculture co-operating, has accomplished such remarkable results and should be continued to a successful conclusion.

Therefore Be It Resolved: That the Section of Plant Quarantine and Inspection at the 42nd Annual Meeting of the American Association of Economic Entomologists at Des Moines, Iowa, December 30th, 1929, endorse and support the continuation of the eradication program, and recommend that the National Plant Board take such steps as they deem advisable in the way of securing support from Congress for adequate funds to eradicate this pest.

GEORGE A. DEAN, *Chairman*,
A. C. FLEURY,
K. C. SULLIVAN, *Committee.*

The motion was put to a vote and carried.

MR. MONTGOMERY: I move that the officers of this Section be instructed to supply a copy of that resolution to the Secretary of Agriculture, to the Chairmen of the Committees on Appropriations of the United States Senate and the House of Representatives; to the National Plant Board, and to the Secretary of the Association.

CHAIRMAN WALLACE: I don't know that we need to vote on that. We will see that it is done.

We will now have the report of the Nominations Committee.

REPORT OF THE COMMITTEE ON NOMINATIONS

The Committee on Nominations recommends as officers of this section for the next year the following: Chairman, Professor E. N. Cory, College Park, Maryland; Secretary, Dr. S. B. Fracker of the U. S. Dept. of Agri., Washington, D. C.

Respectfully submitted,
L. S. MCLAINE
P. A. GLENN
R. W. HARNED, *Chairman*

DR. HEADLEE: I move the adoption of the report and the election of the officers.

The motion was put to a vote and carried.

CHAIRMAN WALLACE: Is there any other business to come before the meeting?

I neglected to ask for any discussion on the reports of the regional boards. If there was any, we could take it up now.

Is there any other business to come before this meeting? If not, we will stand adjourned.

The meeting adjourned at six-ten o'clock.

SUMMARY OF RESULTS OBTAINED WITH TRAP BAITS IN CAPTURING THE CODLING MOTH IN 1927

By M. A. YOTHERS, *Associate Entomologist, Bureau of Entomology, Yakima, Wash.*

ABSTRACT

This paper is a progress report[1] upon the use of attractive baits for capturing the codling moth, *Carpocapsa pomonella* L. Comparisons are made of several kinds of baits in which a total of 17,738 codling moths were captured. Considerable control is evidenced as a result of the experiments made in one orchard although the primary purpose of the experiments was to determine the relative attractiveness of various baits. The relation of temperature fluctuations to flight activity of the moths is presented in graphs, which indicate that there is a very intimate correlation between the two.

[1]Yothers, M. A. Summary of Three Years' Tests of Trap Baits for Capturing the Codling Moth. Journ. Econ. Ent. 20, p. 567, 1927.

THE J. H. WRIGHT ORCHARD (Table 1 and Fig. 51). The test in the J. H. Wright orchard was planned primarily for the purpose of determining the control value against the codling moth of the use of trap baits, supplementing a regular spraying program and continued throughout the season. A block of 100 large Rome Beauty trees was used. This block was surrounded on the north, west, and south by other parts of the same orchard. Bait, consisting of molasses approximately 1–10 to 1–15 dilution, was used in 1½-quart enameled pans suspended in the upper

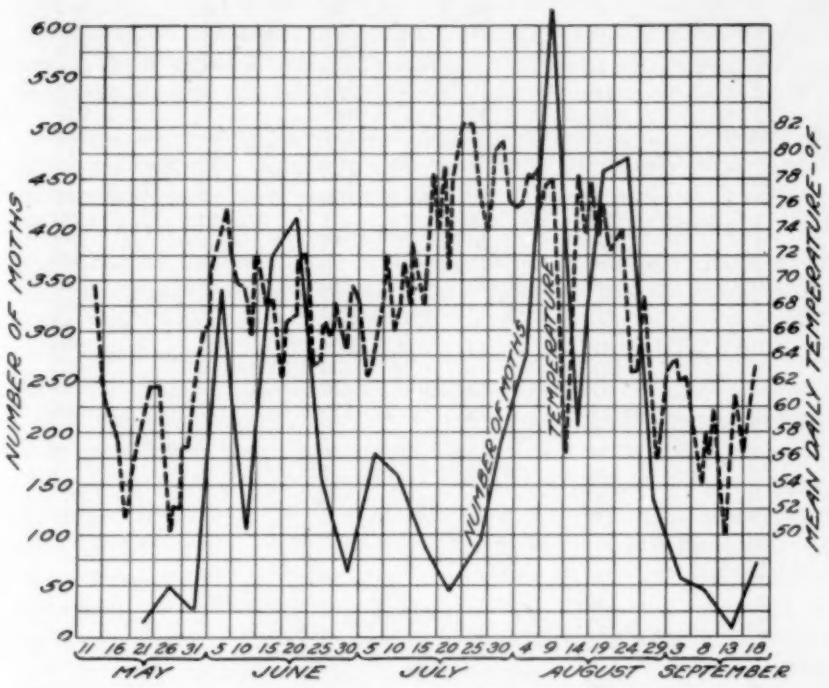

FIG. 51.—The effect of temperature upon the flight activity of the codling moth as indicated by the number of moths captured in trap baits in the J. H. Wright Orchard, Yakima, Wash., 1927.

third of each tree top. Baiting was started May 16, replenishments made every five days, and the test terminated September 18. In all 4,611 codling moths were captured. Spring-brood moths were caught from May 16 to sometime in early July, although most of them were captured in June. First and second brood moths were caught from about the middle of July to the end of the season, most of them, however, during August. In this test, as in another in a different orchard,

there was a considerable increase in the number of moths caught in the middle of what one would expect to be the low period between broods. This also checks with a similar condition in 1926.

TABLE 1. NUMBER OF CODLING MOTHS CAPTURED WITH TRAP BAITS IN TESTS IN THREE ORCHARDS, YAKIMA, WASH., 1927

C. H. Hinman orchard Maximum, 60 bait pans		J. H. Wright orchard 100 bait pans		West Broadway orchard 56 bait pans	
Date	Number of codling moths captured	Date	Number of codling moths captured	Date	Number of codling moths captured
May 5	0	May 21	12	July 28	199
7	0	26	50	30	264
9	0	31	26	Aug. 1	599
10	0	June 5	332	3	419
11	0	10	108	5	995
14	16	15	370	7	965
17	129	20	413	9	921
20	2	25	154	11	678
23	2	30	68	13	11
26	9	July 5	180	15	422
29	3	10	166	17	515
June 1	78	15	89	19	485
4	334	20	40	21	492
7	194	25	88	23	489
10	56	30	192	25	93
13	79	Aug. 4	273	27	56
16	220	9	611	29	40
19	191	14	208	31	10
22	147	19	459	Sept. 2	55
25	37	24	470	4	15
28	14	29	129	6	56
July 1	24	Sept. 3	52	8	0
4	41	8	46	10	2
7	48	13	5		
10	59	18	70		
13	34				
16	23				
19	42				
22	26				
25	40				
28	79				
31	183				
Aug. 3	156				
6	568				
9	503				
12	200				
15	214				
18	637				
21	597				
24	208				
27	64				
30	25				
Sept. 2	24				
5	32				
8	7				
11	1				
Total	5,346		4,611		7,781
Grand total					17,738

Unfortunately, owing to an extremely light crop in the baited plat, no control was evidenced by this use of the baits throughout the season, although there were certain indications of some value, as follows: In the unbaited plat there were over four times as many calyx-wormy fruits as there were in the baited plat, over one-third more side-wormy fruits, and a third more apples which had been entered by more than one worm each, although in this plat there was 50 per cent more fruit and the trees were much smaller. While the crop on the smaller, unbaited trees was light to fair, that on the large, baited trees was extremely light—from half a box to 5 or 6 boxes to the tree where there should have been, in a normal crop, 15 to 20 boxes. This shows that no valid comparisons can be drawn between the results in the baited and unbaited blocks.

THE C. H. HINMAN ORCHARD (Table 2 and Fig. 52). The bait experiments in the C. H. Hinman orchard consisted largely of tests with various kinds of baits, comparison being made especially between different kinds and proportions of molasses. Tests were also made with apple-ferment bait and with baits on poles on a level with the tops of the trees compared with baits in pans hung within the upper third of the tree tops. In all, 5,346 codling moths were captured from May 11 to September 10. Spring-brood moths were captured from May 11 to the end of June. First and second brood moths were captured from late July to September 11. Nearly all of these were caught during August. Baits, this time, were in operation before any moths had emerged, as none were caught on the nights of May 4 to 9 in a brown-sugar ferment, and none on the night of May 10 in 6 pans of molasses-ferment bait. At the expiration of four more nights, May 10 to 13 inclusive, 15 moths were caught, and during the next three nights 83 were caught. Apparently the increasing temperature of May 13 started emergence of the moths, and the greatly increased temperature of the 14th, 15th, and 16th brought them out in considerable numbers.

In the comparison of baits in this orchard, the following points were brought out:

TEST *B. 1, 2.* In a comparison of 3 pans of a light golden colored molasses with 3 pans of high-grade medium dark table molasses, the pans having been used over a period of 25 days from May 10 to June 4, the light molasses caught 160 codling moths against 31 for the medium dark molasses.

TEST *B. 3, 4.* This was another test of the two foregoing materials except that the medium dark molasses had double the quantity of yeast in it. The pans were operated only 9 days, and caught only 11 moths, 8 of which were in the light molasses.

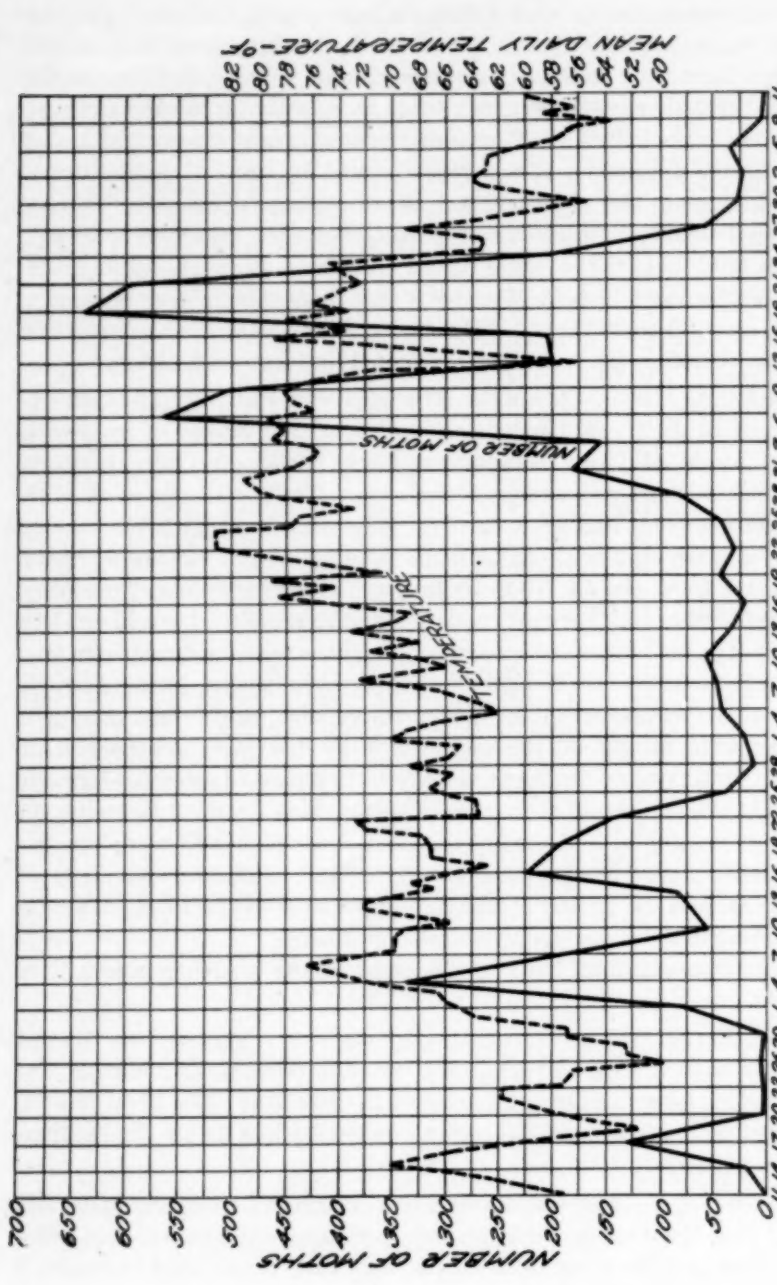

Fig. 52.—The effect of temperature upon the flight activity of the codling moth as indicated by the number of moths captured in trap baits in the C. H. Hinman Orchard, Yakima, Wash., 1927.

TABLE 2. NUMBER OF CODLING MOTHS CAPTURED IN TRAP BAITS, C. H. HINMAN ORCHARD, YAKIMA, WASH., 1927

Test	Material	Dilution	Number of moths captured	Date started	Date finished	Number of days	Number of pans	Average number of moths per pan per day
A	Brown sugar and water	1–10	0	May 4	May 10	6	5	—
B^1	Light golden molasses	1–10	160	10	June 4	25	3	2.13
B^2	Medium dark molasses	1–10	31	10	4	25	3	.41
B^3	Light golden molasses	1– 8	8	June 4	13	9	3	.30
B^4	Medium dark molasses, double amt. of yeast	1–10	3	4	13	9	3	.11
C^1	Medium dark molasses	1–10	906	May 10	Sept. 11	124	5	1.46
C^2	Medium dark molasses	1–20	708	10	11	124	5	1.14
D	Medium dark molasses	1–10	462	29	11	105	5	.88
E	Apple ferment	——	327	29	11	105	5	.62
*F^1	Apple ferment	——	50	June 1	July 19	48	2	.52
*F^2	Medium dark molasses	1–10	77	1	19	48	2	.80
G^1	Medium dark molasses on poles—replenished	1–10	158	4	22	48	5	.66
G^2	Medium dark molasses on poles—water only added	1–10	102	4	22	48	5	.43
H^1	Medium dark molasses	1–10	389	13	Sept. 11	90	3	1.44
H^2	Medium dark molasses. No yeast	1–10	299	13	11	90	3	1.11
**I	Apple ferment and medium dark molasses together	1–10	438	13	11	90	5	.97
J	Medium dark molasses	1–10	180	13	11	90	5	.40
K	Medium dark molasses	1–20	93	13	11	90	5	.21
L	Medium dark molasses	1–10	192	13	11	90	5	.43
M^1	Medium dark molasses on poles	1–20	288	July 22	11	51	5	1.13
M^2	Special dark, heavy molasses on poles	1–20	475	22	11	51	5	1.86

*These four kettles in a single tree. **One part molasses to 10 parts of apple ferment.

TEST *C*. This was a comparison of medium dark molasses 1–10 with the same molasses 1–20, operated throughout the entire season on the outside west row of the orchard. In the 124 days the 1–10 dilution caught 906 moths and the 1–20 caught 708. This difference itself might not be held significant were it not confirmed by other tests in this and another orchard. Probably the dilution of this grade of molasses is less attractive at 1 to 20 than at 1 to 10.

TESTS *D* AND *E*. A comparison of apple-ferment bait with medium dark molasses 1–10 for 105 days from May 29 to September 11, 5 pans being used for each, showed 462 moths caught in the molasses and 327 in the apple bait, an average of 0.88 for the molasses and 0.62 for the apple bait. Again the difference between these might not be of much importance were it not for verification in the following test, for example.

TEST *F*. In this test 2 pans each of molasses and apple ferment were hung approximately equally distant apart in a single large tree. These were operated for 48 days from June 1 to July 19. The molasses (1–10) caught 77 moths and the apple bait 50, an average of 0.80 for the molases and 0.52 for the apple.

TEST *G*. A comparison of bait pans in which the molasses 1–10 was replenished each time of examination with molasses 1–10, and bait pans in which the bait was replenished with water only showed that the regularly replenished molasses caught 158 moths while the water-replenished baits caught 102.

TEST *H*. In a comparison of 3 bait pans in which the molasses bait 1–10 was replenished with the same bait containing yeast and 3 bait pans in which the bait was replenished with molasses 1–10 containing no yeast, it was found that the yeast made the bait more attractive. The bait with yeast captured 389 moths whereas the molasses without yeast caught only 299. There would have been a greater difference than this had not yeast got into the non-yeasted pans through natural agencies or through being carried over accidentally on the strainer used for dipping out the insects. It was not determined whether or not the yeast in the non-yeasted pans was the same yeast as that used in the other pans. This test ran for 90 days with 3 pans each.

TESTS *I*, *J*, *K*, *L*. In these comparable plats comparison was made of the following: Molasses, 1 part to 10 parts of apple ferment without sugar; molasses 1–10; molasses 1–20; and molasses 1–10 with no yeast. These were operated for 90 days in 5 pans each in parallel adjoining rows. The molasses-apple ferment bait caught an average of 0.97 moth per pan per day, the molasses 1–10 caught an average of 0.40, the molasses

1–20 caught an average of 0.21, and the fourth row, with no yeast, caught an average of 0.43.

Here again it is not possible to tell how much of the difference is due to relative value of the materials and how much should be charged to position of the baits with regard to the others. The first row, and by far the most effective bait, judging by results, was probably in a much more advantageous situation than the others. The second and third were less favorably situated, and the fourth again was in a more favorable position on account of the larger number of unbaited trees from which to attract moths.

TEST *M*. A comparison was made of the medium dark molasses 1–20 with a special grade of very dark, heavy molasses also 1–20. Both of these were on poles 51 days, and 5 pans of each bait were used. The dark, heavy molasses caught 475 moths and the medium dark caught 288; an average of 1.86 for the special and 1.13 for the other. Since each of these had about the same number of trees from which to draw moths they should be fairly comparable.

CONTROL VALUE OF TRAP BAITS IN HINMAN ORCHARD. It was not intended that these baits should be of any particular control value for the codling moth in the Winesap block of this orchard where the bait tests were made, as there were only 60 pans operating, at the maximum, in about twice that many trees, with no attention to distribution for control. However, over 5,000 codling moths were captured and the fruit at picking time was practically free of worms and stings—probably not more than a fraction of 1 per cent of both combined. The unusual control may have been due to the spraying program, consisting of two applications of lead arsenate alone and three applications of lead arsenate with the addition of a summer oil, added for San Jose scale control. In the Rome Beauty block (a variety, however, which is supposed to be more susceptible to codling moth infestation) the injury was probably several per cent for both worms and stings. No baits were used in the Rome Beauty tract. Also a considerable number of Rome Beauty trees nearest the baits in the Winesap block, and 6 in some old trees separating the two blocks, were very much more free of larvae under the bands than elsewhere in the Rome block. Apparently the bait traps attracted the moths for 3 or 4 tree rows outside of the baited area.

WEST BROADWAY ORCHARD (Table 3 and Fig. 53). In these experiments duplicate tests were run in approximately alternate trees, with baits upon poles at the level of the tops of the trees in comparison with similar baits hung in the upper third of the tree tops. In all nine cases,

except one, the pans on the poles captured more moths than those in the tree tops. The single exception is accounted for by the poor trees and the falling of certain poles. Evidently it is very well verified now that more moths are captured at the top of the trees than down in the tree tops.

All of the tests in this series are fairly comparable, except that those starting first (July 23) have a little bit the disadvantage since at this time moths were not emerging in as great numbers as they were on

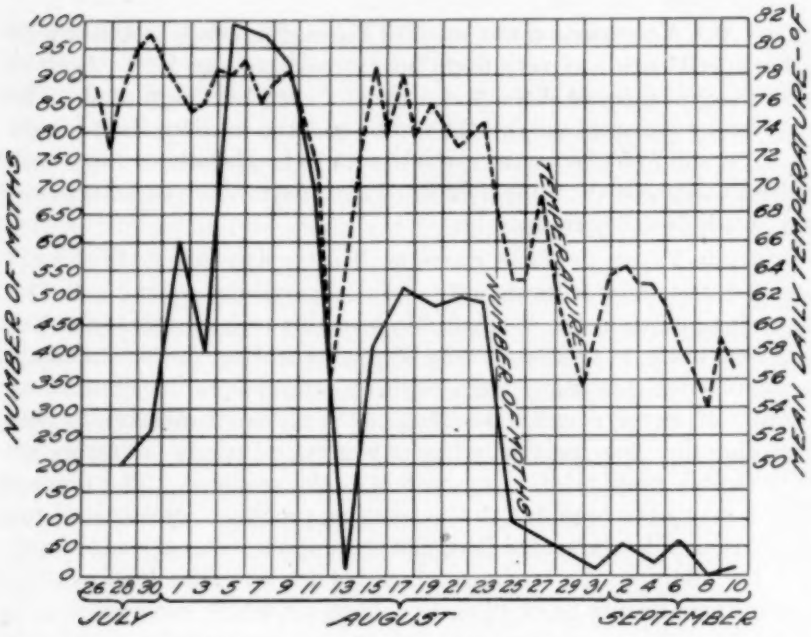

Fig. 53.—The effect of temperature upon the flight activity of the codling moth as indicated by the number of moths captured in trap baits in the West Broadway Orchard, Yakima, Wash., 1927.

July 28 and August 3, when the other tests were begun. However, this disadvantage does not influence greatly the final results.

In these experiments it is indicated that the medium dark molasses 1–10 on poles was the best material, averaging 5.41 moths per pan per day. The next best was the apple bait on poles, averaging 3.80. The stock-feeding molasses did not show much value compared with the other grades.

TABLE 3. NUMBER OF CODLING MOTHS CAPTURED IN TRAP BAITS, WEST BROADWAY ORCHARD, YAKIMA, WASH., 1927

Test	Material	Dilution	Position of pans	Number of moths captured	Date started	Date finished	Number of days	Number of pans	Average number of moths per pan per day Separately	Together
A	Apple ferment	——	In trees	495	July 23	Sept. 10	49	3	3.37	
			On poles	558	23	10	49	3	3.80	3.58
B	Medium dark molasses	1–20	In trees	381	23	10	49	3	2.59	
			On poles	527	23	10	49	3	3.59	3.09
C	Medium dark molasses	1–10	In trees	547	23	10	49	3	3.72	
			On poles	796	23	10	49	3	5.41	4.57
D	Medium dark molasses. Water only added 2 out of 3 times	1–20	In trees	366	28	10	44	3	2.77	
			On poles	448	28	10	44	3	3.39	3.08
E	Medium dark molasses. No yeast	1–10	In trees	309	28	10	44	3	2.34	
			On poles	394	28	10	44	3	2.98	2.66
F	Medium dark molasses	1–30	In trees	449	28	10	44	4	2.55	
			On poles	747	28	10	44	4	4.24	3.40
G	Medium dark molasses. Yeast added first time only	1–10	In trees	366	28	10	44	3	2.77	
			On poles	488	28	10	44	3	3.70	3.23
H	Stock-feeding molasses	1–20	In trees	233	Aug. 3	10	38	3	2.04	
			On poles	158	3	10	38	3	1.39	1.71
I	Stock-feeding molasses	1–40	In trees	188	3	10	38	3	1.65	
			On poles	331	3	10	38	3	2.90	2.28
	Total and average		In trees	3,334					2.69	
			On poles	4,447					3.58	3.13

THE RELATION OF TEMPERATURE TO MOTH ACTIVITY. The opinion expressed by the writer in a previous paper[2] that there is a rather consistent relation between temperature and codling moth activity, as shown by captures of moths in trap baits, is borne out by results obtained in 1927, as is shown in Figures 51, 52, and 53. In general, considerable increases in temperature are accompanied or followed by considerable increases in the number of moths captured, and considerable decreases in temperatures by conspicuous decreases in number of moths attracted to the baits. Notable *increases* in temperature and number of moths captured are shown in Figure 51 on May 21–26, June 5, August 19, and September 18; in Figure 52, on May 14–17, June 4, June 16, July 31, and August 6 and 18; in Figure 53, on August 1, 5, and 15–23. Notable *decreases* in both temperature and number of moths captured are indicated, in Figure 51, on May 31, June 10 and 30, August 12–14, and August 29; in Figure 52, on May 20 to 29, June 10 and 23–25, August 3, 12–15, and 24–27; in Figure 53, on August 3, 13, and 25.

CONCLUSIONS. This fourth season's experiments with trap baits confirms previous conclusions that many thousands of codling moths can be captured in properly operated trap baits.

This season's tests in which apple-ferment bait was compared with molasses-ferment bait confirm those of 1926 that the molasses bait is somewhat more attractive than the former.

Certain cheaper grades of molasses are apparently as attractive as the higher-priced brands, although the "stock-feeding" molasses was found far less attractive.

Bait pans when operated at a level with the tops of the trees capture more moths than when placed within the tree tops.

The addition of yeast to molasses gives better results than depending upon chance fermentation.

The medium dark molasses seems to reach its maximum efficiency at a dilution between 1–10 and 1–20, but heavier grades may be diluted more, possibly as much as 1–20.

Better results were obtained in replenishing molasses bait with the regular formula than with water alone, although yeast need not be added at each replenishment.

The measure of supplementary control value of trap baits, as thus far developed, is still problematic, but doubtless the elimination of thousands of female moths containing eggs must indicate some reduction in the amount of infestation.

[2]See footnote on page 576.

As a means for determining the presence and abundance of codling moths in the orchard to determine spraying dates, the trap baits are worth while, and are being used for that purpose by hundreds of orchardists in the Wenatchee and Yakima Valleys of Washington.

A SIMPLE STATISTICAL METHOD FOR DETERMINING THE APPROXIMATE DURATION OF THE INSTARS OF LEAF-MINING LARVAE AND OTHERS

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ABSTRACT

It is usually laborious and difficult to determine satisfactorily the duration of the larval instars of those forms which molt in leaf-mines, bear cases, or are otherwise not readily measured without removal from shelter. A simple statistical method, which has several advantages, is described. Comparative data on *Phyllotoma nemorata* (Fallén) and *Coleophora salmani* Hein. are given as examples.

It is often desirable in insect life-history work to know the period of each larval instar, *i.e.*, the length of the several stadia. The usual method of periodical observations upon labeled individuals in culture for the determination of the duration of these stages has several disadvantages when applied to leaf-miners, case-bearers, and other forms whose ecdyses occur within an opaque structure.

The usual procedure might include, at the start of the study, a necessarily large series of eggs, each one designated, and an examination of the lot at regular time intervals, both before and after hatching. Unfortunately, a larva in a mine usually may not be measured[1] accurately without removal. It is evident that a leaf-mine opened for the removal of a larva no longer can provide the same environment for that larva; additionally, if it be replaced and the aperture not sealed (as is usually not feasible), the larva is extremely apt to escape from the mine; lastly, the handling of the larva, even if it is not visibly injured, may well have an effect on the length of the stadium.

These disadvantages may be eliminated if small *fractions* of the original lot are examined (and discarded at each interval) until a representative number of the larvae have reached, for example, the second

[1]The measurement of the head capsule, which, as Dyar (1890) noted is not subject to growth during a stadium, is the logical one to make and, thus, to classify larvae. (Dyar's Rule, that the head measurements of the instars form a geometrically progressive series, is, of course, too well known to amplify here.) A paper showing that Dyar's Rule may be applied to successive instars with greater reliability when based on *averaged* measurements of known instars, is in preparation.

instar. The figures thus obtained, when averaged, give a mean duration of the first instar. This procedure with other arbitrary portions of the remainder in each stage, repeated for each stadium until *all* of the lot have been utilized, may give a mean for each instar. It is obvious that the number started with must be large. It is likewise apparent that, unless the mining habits of each instar be strikingly dissimilar so that positive determinations can be made throughout macroscopically the investigator with this method is obliged to establish his "mean duration of instar" as definite periods as he proceeds, *i.e.*, *all* the larvae in the lot of undissected mines must be *assumed* to have molted at the precise time the mean (based on a fraction of the lot) just determined would apply.[2] With this method it is clear, unfortunately, that there is always the decided possibility that the number of samples will be too small to give a truly representative mean in each case. Especially, if slight errors should be cumulative, later data might be considerably at variance with the truth. Lastly, larvae so studied are often in culture in the laboratory under conditions which, at their best, are merely approximations of those in the field.

While examining a series of white birch (*Betula papyrifera*) leaves daily for other data, a simple "statistical" method to determine the approximate duration of larval instars came to mind—one that has probably occurred to other workers but which had not been observed in the literature[3]—which may prove advantageous. This method, with an equivalent amount of time and labor, permits the examination of a larger sample of material, and uses material fresh from the field where it

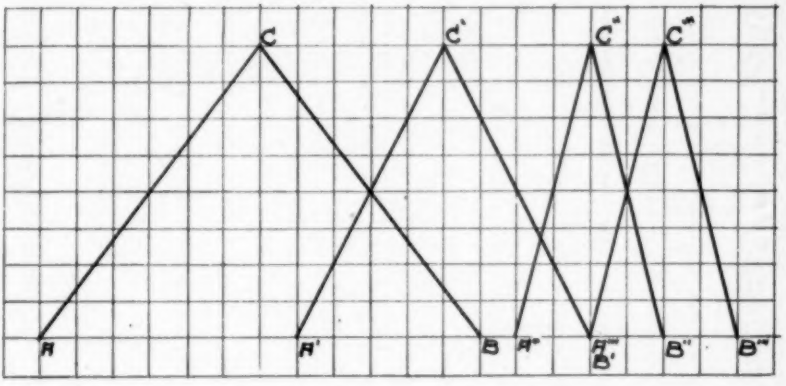
[2]A simple hypothetical case: 1000 first instar larvae under consideration; 10, or one per cent, subject to dissection each day for ten days; the first post-embryonic ecdysis noted to occur at a range of five to ten days after hatching, with a mean, perhaps, of 8.3 days. This figure is then taken to fix the time of the first molt for the remaining ninety per cent of the original lot, and so on for successive stadia.

[3]Though not known at the time, Laughlin, a cytologist, used a somewhat analogous method to determine the length of the several phases in mitosis when he found them to be directly proportional, roughly, to the comparative abundance of the mitotic figures in sectioned material.

The following statement in a paper by Calvert (1929) was not seen until this article was in press:

"Two methods of ascertaining the duration and the differences in size and in structure of the successive instars of insects have been discussed by Wesenberg-Lund (1913, pp. 374 *et seq.*) with special reference to the Odonata, that of rearing known individuals in aquaria and that of comparing specimens taken in nature at regular intervals (analysis of populations). He has set forth the obstacles which he met in following each of these. Unquestionably the former method—that of rearing—gives the most dependable results when its technical difficulties are overcome."

has had the advantage of continuous natural conditions. Briefly, it includes the collection of mines at regular intervals, the positive determination of the stages with the aid of an ocular micrometer disc, and the entry of these data to show the number of each instar obtained at each interval. Determinations, of course, should immediately follow collection since development will continue in neglected material. The value of the data secured is dependent upon the size of the sample taken, the frequency of the interval, and, especially, the uniformity of the source of the material. In effect, the area collected from, if it approximates a constant, becomes a transcendent laboratory culture.



$$\begin{matrix} AA' : 7 \\ BB' : 3 \end{matrix} \quad CC' : 5 \quad \begin{matrix} A'A'' : 6 \\ B'B'' : 2 \end{matrix} \quad C'C'' : 4 \quad \begin{matrix} A''A''' : 2 \\ B''B''' : 2 \end{matrix} \quad C''C''' : 2$$

Fig. 54.—Diagram to show that, even though successive stadia may be spread over greater or lesser periods, when the curves are symmetrical distances $\frac{AA'+BB'}{2} = CC'$, $\frac{A'A''+B'B''}{2} = C'C''$, etc.

The larvae measured at each time interval are a classified "cross-section" of the population of the given area at those times.

The length of each stadium may be calculated as the distance in days (or half-days) from one mean to the next, or more simply, if the mean be arbitrarily taken as *half-way* between the extremes of the first and last dates when a given instar occurs in the material, then the "distance" from the first date of one stage to the first date of the next, plus the distance between the last dates of the same two stages, divided by two, will give the same figure with less trouble. Fig. 54 illustrates this. The basis for the use of this arbitrary mean is the assumed tendency on the part of the larva instars to form frequency curves which are symmetrical and without skew.

TABLE 1. THE INCIDENCE OF THE SEVERAL STAGES OF THE BIRCH LEAF-MINING, SAWFLY, *Phyllotoma nemorata* (FALLÉN) AND OF THE BIRCH CASE-BEARER *Coleophora salmani* HEIN., BY DATE*

	Phyllotoma								Coleophora					
Date	Egg	I	II	III	IV	V	VI	VII	Egg	I	II	III	IV	V
6/15	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/16	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/17	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/18	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/19	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/20	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/21	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/22	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/24	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/25	0	–	–	–	–	–	–	–	–	–	–	–	–	–
6/26	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/27	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/28	x	–	–	–	–	–	–	–	–	–	–	–	–	–
6/29	0	–	–	–	–	–	–	–	–	–	–	–	–	–
7/1	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/2	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/3	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/4	0	–	–	–	–	–	–	–	–	–	–	–	–	–
7/5	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/6	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/8	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/9	x	–	–	–	–	–	–	–	–	–	–	–	–	–
7/10	x	x	–	–	–	–	–	–	–	–	–	–	–	–
7/11	x	x	–	–	–	–	–	–	–	–	–	–	–	–
7/12	x	x	–	–	–	–	–	–	–	–	–	–	–	–
7/13	x	x	–	–	–	–	–	–	–	–	–	–	–	–
7/15	x	x	–	–	–	–	–	–	–	–	–	–	–	–
7/16	x	x	–	–	–	–	–	–	–	–	–	–	–	–
7/17	x	x	–	–	–	–	–	–	–	–	–	–	–	
7/18	–	0	–	–	–	–	–	–	x	–	–	–	–	–
7/19	–	x	x	–	–	–	–	–	x	–	–	–	–	–
7/20	–	0	0	–	–	–	–	–	x	–	–	–	–	–
7/22	–	x	x	–	–	–	–	–	x	–	–	–	–	–
7/23	–	x	x	–	–	–	–	–	x	–	–	–	–	–
7/24	–	x	x	–	–	–	–	–	x	–	–	–	–	–
7/25	–	x	x	–	–	–	–	–	x	–	–	–	–	–
7/26	–	x	x	x	–	–	–	–	x	–	–	–	–	–
7/27	–	x	x	x	–	–	–	–	x	–	–	–	–	–
7/29	–	x	x	x	–	–	–	–	x	–	–	–	–	–
7/30	–	x	x	x	–	–	–	–	x	–	–	–	–	–
7/31	–	x	x	x	–	–	–	–	x	–	–	–	–	–
8/1	–	x	x	x	–	–	–	–	x	–	–	–	–	–
8/2	–	x	x	x	–	–	–	–	x	–	–	–	–	–
8/3	–	–	x	x	x	–	–	–	x	–	–	–	–	–
8/5	–	–	x	x	x	–	–	–	x	–	–	–	–	–
8/6	–	–	x	x	0	–	–	–	x	–	–	–	–	–
8/7	–	–	x	x	x	–	–	–	x	x	–	–	–	–
8/8	–	–	x	x	x	–	–	–	x	x	–	–	–	–
8/9	–	–	x	x	x	–	–	–	x	x	–	–	–	–
8/10	–	–	x	x	x	–	–	–	x	x	–	–	–	–

*The actual number per day are not given since, in these cases, they were not used to determine the true mean; instead, the arbitrary mean of the point half-way between the first and last date of the incidence of a given stadium was used as a basis for calculation.

TABLE 1—*Continued*

	Phyllotoma								Coleophora					
Date	Egg	I	II	III	IV	V	VI	VII	Egg	I	II	III	IV	V
8/12	–	–	x	x	x	x	–	–	x	x	–	–	–	–
8/13	–	–	–	0	x	0	–	–	x	x	x	–	–	–
8/14	–	–	–	x	x	x	–	–	x	x	x	–	–	–
8/15	–	–	–	x	x	x	–	–	x	x	x	–	–	–
8/16	–	–	–	x	x	x	–	–	x	x	x	–	–	–
8/17	–	–	–	x	x	x	–	–	0	x	x	–	–	–
8/19	–	–	–	x	x	x	x	–	x	x	x	–	–	–
8/20	–	–	–	x	x	x	0	–	x	x	x	–	–	–
8/21	–	–	–	x	x	x	x	–	x	x	x	–	–	–
8/22	–	–	–	x	x	x	x	–	x	x	x	–	–	–
8/23	–	–	–	x	x	x	x	–	x	x	x	–	–	–
8/24	–	–	–	–	x	x	x	–	–	x	x	–	–	–
8/26	–	–	–	–	x	x	x	–	–	x	x	–	–	–
8/27	–	–	–	–	x	x	x	–	–	x	x	–	–	–
8/28	–	–	–	–	x	x	x	–	–	x	x	–	–	–
8/29	–	–	–	–	x	x	x	–	–	x	x	–	–	–
8/30	–	–	–	–	x	x	x	–	–	x	x	–	–	–
8/31	–	–	–	–	–	x	x	–	–	x	x	x	–	–
9/2	–	–	–	–	–	x	x	x	–	x	x	x	–	–
9/3	–	–	–	–	–	0	x	0	–	x	x	x	–	–
9/4	–	–	–	–	–	x	x	0	–	x	x	x	–	–
9/5	–	–	–	–	–	x	x	0	–	x	x	x	–	–
9/6	–	–	–	–	–	x	x	x	–	x	x	0	–	–
9/7	–	–	–	–	–	0	x	0	–	x	x	0	–	–
9/9	–	–	–	–	–	0	x	x	–	–	x	x	–	–
9/10	–	–	–	–	–	x	x	0	–	–	x	x	–	–
9/11	–	–	–	–	–	–	x	x	–	–	x	x	–	–
9/12	–	–	–	–	–	–	x	0	–	–	x	x	–	–
9/13	–	–	–	–	–	–	x	0	–	–	x	x	–	–
9/14	–	–	–	–	–	–	x	x	–	–	x	x	–	–
9/16	–	–	–	–	–	–	0	x	–	–	x	x	–**	–
9/17	–	–	–	–	–	–	0	0	–	–	x	x	–	–
9/18	–	–	–	–	–	–	0	0	–	–	x	x	–	–
9/19	–	–	–	–	–	–	0	0	–	–	x	x	–	–
9/20	–	–	–	–	–	–	0	0	–	–	0	x	–	–
9/21	–	–	–	–	–	–	0	x	–	–	0	x	–	–
9/23	–	–	–	–	–	–	x	x	–	–	0	x	–	–
9/24	–	–	–	–	–	–	–	x	–	–	x	x	–	–
9/25	–	–	–	–	–	–	–	x	–	–	–	x	–	–
9/26	–	–	–	–	–	–	–	0	–	–	–	x	–	–
9/27	–	–	–	–	–	–	–	x	–	–	–	0	–	–
9/28	–	–	–	–	–	–	–	x	–	–	–	x	–	–
9/30	–	–	–	–	–	–	–	x	–	–	–	x	–	–
10/1	–	–	–	–	–	–	–	x	–	–	–	x	–	–
10/2	–	–	–	–	–	–	–	0	–	–	–	x	–	–
10/3	–	–	–	–	–	–	–	x†	–	–	–	x	–	–
10/4	–	–	–	–	–	–	–	–	–	–	–	x	–	–
10/5	–	–	–	–	–	–	–	–	–	–	–	x	–	–
10/7	–	–	–	–	–	–	–	–	–	–	–	0	–	–
10/8	–	–	–	–	–	–	–	–	–	–	–	0	–	–
10/9	–	–	–	–	–	–	–	–	–	–	–	x	–	–

**The data for the fourth instar were incomplete, while the fifth instar does not occur until the following spring.

†Note: While seventh instar larvae may be found throughout the winter, this was the last date when any which had not spun the lens-shaped hibernaculum were obtained from the regular area of collection.

TABLE 2. THE DURATION BY DAYS OF THE SEVERAL STAGES OF *Phyllotoma nemorata* AND *Coleophora salmani* AS OBTAINED BY COMPARATIVE METHODS

Stage	Phyllotoma		Coleophora	
	By Culture	Statistically	By Culture	Statistically
Egg	No. cases: 44 Range: 12–33 Modes: 17, 19. Mean: *20.8*	1st. egg–1st. I (6/15–7/10): 25 last to last (7/17–8/2): 16 41 ÷ 2: *20.5*	No. cases: 84 Range: 17–24 Modes: 18, 22 Mean: *19.5*	1st. egg–1st. I (7/18–8/7): 20 last to last (8/23–9/7): 15 35 ÷ 2: *17.5*
I	No. cases: 3 Range: 8–11 Mean: *9.3*	1st. I–1st. II (7/10–7/19): 9 last to last (8/2–8/12): 10 19 ÷ 2: *9.5*	No. cases: 65 Range: 7–14 Modes: 11, 13 Mean: *10.8*	1st. I–1st. II (8/7–8/13): 6 last to last (9/7–9/24): 17 23 ÷ 2: *11.5*
II	*dissected* No. cases: 2 Mean: *10* *estimated* No. cases: 32 Range: 8–14 Modes: 11, 14 Mean: *11.7*	1st. II–1st III (7/19–7/26): 7 last to last (8/12–8/23): 11 18 ÷ 2: *9*	No. cases: 23 Range: 13–16 Modes: 14, 15 Mean: *14.5*	1st. II–1st. III (8/13–8/31): 18 last to last (9/24–10/9): 15 33 ÷ 2: *16.5*
III	*dissected* No. cases: 4 Range: 6–9 Mode: 7 Mean: *7.25* *estimated* No. cases: 27 Range: 5–9 Modes: 6, 8 Mean: *7.3*	1st. III–1st. IV (7/26–8/3): 8 last to last (8/23–8/30): 7 15 ÷ 2: *7.5*		
IV	*dissected* No. cases: 4 Range: 6–8 Mode: 8 Mean: *7.25* *estimated* No. cases: 19 Range: 6–9 Modes: 7, 6 Mean: *6.8*	1st. IV–1st. V (8/3–8/12): 9 last to last (8/30–9/10): 11 20 ÷ 2: *10*		
V	*dissected* No. cases: 3 Range: 7–8 Mode: 8 Mean: *7.7* *estimated* No. cases: 13 Range: 6–8 Modes: 7, 8 Mean: *7.4*	1st. V–1st. VI (8/12–8/19): 7 last to last (9/10–9/23): 13 20 ÷ 2: *10*		

TABLE 2—*Continued*

VI	No. cases: 11 Range: 20–26 Modes: 20, 22 Mean: *21.9*	1st. VI–1st. VII (8/19–9/2): 14 last to last* (9/23–10/3): 10 24÷2: *12*
VII (Prehibernaculum period only)	No. cases: 9 Range: 3–11 Modes: 7, 3 Mean: *5.9*	1st. VII–1st. hibernaculum (9/2–9/9): *7***

**i.e.*, last date seventh instar found without a hibernaculum.
***The date, Sept. 9, for the first hibernaculum noted is not given in Table 1.

In contrast with the method first discussed, the definite age of no individual larva is ever obtained; it may be pointed out, however, that the age of an individual is usually of importance only to the extent that it contributes to the determination of a mean. *That*, apparently, can be derived closely by the method just described. Two cases, unfortunately with samples smaller than desirable— since no critical test of this was planned originally— may be of interest. These data[4] were obtained incidentally while engaged in securing other data.

The *Phyllotoma* data in the tables are based upon a daily random collection of 15 white birch leaves, a sample which contained up to 35 larvae; the daily sample for the *Coleophora* data, which were taken by A. M. Gillespie, Junior Entomologist, Maine Forest Service, was 100 white birch leaves; this latter material yielded up to 69 eggs and up to 51 larvae daily. Care was taken to collect over the same route on a permanently delimited area, while the factors of shade or sun and the like were kept as uniform as possible.

DISCUSSION. It may be noted that, even with these small samples, the data obtained by the comparative methods are reasonably consistent with the exception of a considerable discrepancy in the duration of the sixth instar in *Phyllotoma*. This, possibly, can be explained partly by the smallness of the sample in both cases, and partly by the tendency for cumulative error when the progressive development of a lot is estimated to have reached definite points from the determinations of the duration of the several stages obtained from small fractions of this lot. It may be said, in addition, that there is an apparent tendency on the part of these sawfly larvae to have a more irregular stadium in

[4]These data were obtained in the course of a biological study upon these economically important insects and were used with the permission of H. B. Peirson, Entomologist of the Maine Forest Service.

the sixth instar than in the earlier instars. It was definitely noted, for example, that drouth markedly decreased the feeding rate and unduly prolonged the sixth stadium. On a number of occasions, sixth instar larvae, which had become quiescent, resumed feeding after a local shower had apparently increased the succulence of the leaf tissue, ceased a day or so later, and resumed again at the incidence of a second shower. It is natural that such irregularities would be more apparent with a small sample than with a larger one.

There are, of course, a number of more or less tacit assumptions in force when this statistical method is operative. These include: (1) As mentioned, the basic and rather inclusive assumption that the periodical incidence of a given instar will form, as it waxes, reaches a peak, and wanes, a symmetrical inverted V-shaped curve. (2) The assumption that all larvae are impelled to, and do, molt after a definite summation of factors such as units of ingested food, thermal increments, and the like. (3) The assumption that the date of the initiation of a stage has no effect upon the length of that stage, *e.g.*, the hatching period, tends to be of the same length regardless of whether the egg was the first one laid, the last one, or any intermediate one during the oviposition period, etc. (4) The assumption that the mean duration of any instar is unaffected by the death rate (from any and all causes) of that instar. (5) The assumption that all plant units of the delimited collection area are subject to an identity of those conditions which foster development of the insect. There are other assumptions, of minor importance, of about the same order.

There is some source of Error in all these assumptions; the Probable Error could be determined, probably, only after a special, modified formula had been obtained to fit these assumptions. A critical test of this statistical method, with the refinements afforded by large samples and short time intervals, might be worth while and should aid in the development of formulae that would assist in securing still closer approximations of the truth. Basically, however, the principle of this statistical method would appear to be sound and to prove at least as accurate for the special class of larvae considered, as the first method discussed.

It may not be amiss to pause briefly, and to interpolate these speculative queries:

1. Which is the more important factor in ecdysis, an accumulation of temperature (thermal increments as used by Peairs) *or* the number of decigrams of food consumed?

2. If these and other factors be reasonably definite, how advisably may the duration of a larval instar be expressed in such coarse units as days?

Unless a number of counts, very much larger than usual, be made, a "normal season" be determined, and certain variables be evaluated, it would seem that the length of no larval instar can be given as anything but an approximation. In economic entomology, however, it is very often essential that some concept of the duration of the several larval stadia be obtained. These approximations, derived as accurately as possible, are useful and are very much better than no data at all.

It is not suggested that the statistical method treated herein might be preferable with insects whose immature stages may be kept visible at all times, or where material is scarce. It is believed, however, in the case of certain leaf-miners, case-bearers, and other larvae, the molts of which are hidden from view, and when in abundance, that this method may be found fully as accurate as any other; that it is time-saving (since caging and numbering are eliminated); and that it possesses the still further advantage that other data[5] may be obtained simultaneously. Care should be taken to make the sample adequately large, the time interval short and, especially, to keep the area of collection approximately a constant.

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[5]Such as the percentage of infestation, the number of mines per plant unit, the parts of the plant affected, etc.

SUPPLEMENTARY CONTROL MEASURES FOR THE ORIENTAL FRUIT MOTH[1]

By S. C. CHANDLER, *Illinois State Natural History Survey*

ABSTRACT

Bands placed around peach trees in spring caught an average of 2.2 Oriental Fruit Moth larvae per band up to the time of Elberta harvest. Bands placed on Krummel's October and Heath Cling peach trees after Elberta harvest caught from 6 to 151 larvae per band for the rest of the season. An interesting larval habit in connection with banding is discussed.

Paradichlorobenzene showed poor results in grower made treatments in 1928. Tests by the author in 1929 gave a kill of from 70% to 90%.

During the fall of 1928 and of 1929 banding and the use of paradichlorobenzene for the Oriental Fruit Moth, *Laspeyresia molesta* Busk, were tested in southern Illinois.

BANDING

Bands placed late in the season of 1928 gave sufficient promise to warrant further tests. In the spring of 1929, 10 bands were placed in each of four Elberta peach orchards in Pulaski County, Illinois, which is the area most heavily infested in the state. The two types of bands used were of material commonly employed for bagging. Both were tarred on the inside, and in addition the surface placed next to the tree was faced with burlap in the case of one and a cheese cloth of wide mesh in the case of the other. Both types had been among the best in our Codling Moth tests. The selection of orchards was made as follows;—

Orchard No. 1, given little care, trees located close to quinces badly infested in 1928.

Orchard No. 2, given moderate care, trees selected in and next to a block of Krummel's October which was 35% infested in 1928. (Krummel block listed as Orchard No. 5 in Table 2.)

Orchard No. 3, given best of care, showing the greatest infestation in 1928 of any Elberta orchard in the section.

Orchard No. 4, given moderate care, selected merely for geographical location in the peach section.

Table 1 gives the numbers of larvae and pupae collected under the 40 bands in the above mentioned orchards.

[1]Contribution No. 3 of Project 10.6, Ill., State Natural History Survey.

TABLE 1. NUMBERS OF LARVAE AND PUPAE COLLECTED FROM BANDS IN ELBERTA PEACH ORCHARDS

Date Collected	Larvae and Pupae Collected from Orchards No. 1	No. 2	No. 3	No. 4	Total	Tree Average
May 22	4	3	0	0	7	.17
May 28	3	2	0	0	5	.12
June 6	1	0	0	0	1	.002
June 11	0	0	0	0	0	0.
June 27	–	–	5	–	5	.02
July 8	3	5	1	1	10	.25
July 22	1	1	2	2	6	.15
July 30	7	4	13	4	28	.7
Aug. 8	5	5	15	2	27	.7
Aug. 19 (after harvest)	0	0	0	0	0	0.0
Season's Totals	24	20	36	9	89	2.2

As will be seen by an inspection of Table 1 the bands in Orchards No. 1 and 2, located next to sources of the winter's carry-over, caught the first larvae of the season. After the middle of June, when twig infestation had spread to all orchards, bands in Nos. 3 and 4 began catching larvae. After that time the thriftiest of all, No. 3, outstripped the others in total larvae collected. This orchard proved to be one of the worst infested Elberta orchards of the section that year, as it had been in 1928, yet it will be seen that a total of only 36 larvae were collected from 10 bands in it, or 3.6 per band for the season. The average for the four orchards was only 2.2 larvae per band. It would seem from this that up to the time of the Elberta harvest banding was ineffective.

After the Elberta harvest, Krummel's October and Heath Clings, were banded. Table 2 gives the record of these collections.

TABLE 2

Date Collected	Number of Larvae and Pupae Collected Orchard No. 5	Orchard No. 6	Orchard No. 7 Block 1	Block 2
Sept. 3	288	—	—	—
Sept. 9	76	—	—	—
Sept. 5	—	639	1165	—
Sept. 19	—	435	—	—
Sept. 21 and 23	—	—	2471	—
Sept. 23–25	—	—	—	2112
Totals	364	1074	3636	2112
No. of bands	62	20	24	61
Average per band	5.9	53.7	151.5	34.6
Date banded	Aug. 19	Aug. 26	Aug. 26	Sept. 5
Collection period	21 days	24 days	27 days	20 days

It will be seen that the averages of totals per band range from 5.9 to 151.6. The following statements may account in part for these big differences;—

Orchard No. 5 was banded on August 19, and the peaches harvested earlier than usual, September 1. Trees were stripped of fruit by September 3 and all drops picked up in the next few days.

Orchard No. 6 was picked by September 19, and all drops removed and buried.

Orchard No. 7 offered the greatest possibilities for the collection of larvae. Due to infestation and prices very few peaches were picked, and most of the drops were allowed to remain on the ground. Cheesecloth faced bands were used in all of the orchards except Block 2 of No. 7, where a tarred felt was used. The greatest difference between these two blocks in the same orchard, however, was in the size of the trees. Block 1 produced a much larger crop per tree. The average circumference of the trunks where the bands were placed was 21.4 inches in Block 1 and 12.5 inches in Block 2. From Table 2 it would appear that banding late maturing varieties after the Elberta season offers possibilities. It certainly provides a convenient method of collecting a winter's supply of larvae for the entomologist.

To determine the direction from which the larvae come that enter the bands a few trees were banded both on the trunks and in the main branches. About as many larvae were found in the upper as in the lower bands, indicating that they come from both directions. In Orchards 6 and 7 where such large numbers of larvae were found, it was noticed that fully 75% of the larvae cocooned just inside the band, making in many trees a nearly solid ring of cocoons, both at the upper and lower edges of the band. About as many were in the upper bands as in the lower.

USE OF PARADICHLOROBENZENE. In the fall of 1928 trees treated by the growers with P. D. B. at the usual rates per tree were examined for live Oriental Fruit Moth larvae. Table 3 summarizes the data obtained.

TABLE 3. USE OF P.D.B. IN GROWER TREATED ORCHARDS IN 1928

Orchard No.	Date Treated	Date Examined	No. Trees Examined	Larvae Found Live	Dead	Total	% Dead
1.....	Sept. 25	Oct. 30	7	26	14	40	35%
2.....	Oct. 10–13	Nov. 5	5	6	2	8	25%
3.....	Oct. 19	Nov. 20	2	84	12	96	12%

In the fall of 1929 trees were treated by the author in two orchards, using 1 oz. of P. D. B. on 7 year old trees. In one of them, listed as No. 4 in Table 4, the trees were treated in the regular manner. In the other, Orchard No. 5, the ground level was first raised 3 to 4 inches in order to bring the material within reach of as many larvae as possible. Both

orchards were treated September 28 and examined October 11 to 15. In No. 4, 20 trees were treated and 20 left for a check, but unfortunately all but 7 of each were pulled out before they could be examined. In No. 5 because of the irregular procedure of raising the ground level, a check was kept on the kill of peach borer larvae, *Aegeria exitiosa* Say. These data are presented in Table 4.

TABLE 4. USE OF P.D.B. IN EXPERIMENTAL ORCHARD IN 1929

		Oriental Fruit Moth Larvae						Peach Borer Larvae					
		Treated			Check			Treated			Check		
No.	Treatment	Live	Dead	% Dead	Live	Dead	% Dead	Live	Dead	% Dead	Live	Dead	% Dead
4	Regular	3	30	90%	68	6	8%	–	—	——	—	–	–
5	Ground level raised	35	116	70%	189	6	3%	3	29	90%	17	0	0

The applications were made with the ground in good condition. A record of soil temperatures 3 inches below the surface showed a maximum of 72° F. on the north side of the tree for the first two days. After a rain of .66 inch temperatures were lower for the rest of the period between treating and examining, but the minimum was never lower than 55 at night on the north side. The maximum in the middle of the day was 66. One other rain of .42 inch occurred 8 days after treatment.

An examination of Tables 3 and 4 will show that the efficacy of P. D.B. is not a foregone conclusion. In the case of Orchards No. 2 and 3 the poor kill may have been due to too late applications. Our recommended dates for this section are from September 25 to October 15, for the Peach Borer, but the latter date may depend upon soil temperatures. Table 4 would indicate that the practice of first raising the ground level might result in a reduction in kill. It will be seen that under conditions that killed 90% of the peach borer larvae, 70% of the Oriental Fruit Moth larvae were killed.

In the hibernation studies carried on during the winter of 1928–29 by the author, it was found that of 487 larvae found on trees, 33% were located between the ground line and a point 3 inches above the ground, and might be reached by P. D. B. These records were made from trees headed at the average height. It may be that on very low headed trees a larger percent might be reached.

In considering both the practices of banding and the use of P. D. B. it should be clearly born in mind that numbers of larvae on late maturing varieties like Krummel's October are vastly greater than on the two principal varieties, Elberta and Hale. During the winter of 1928–29 hibernation studies of 5 Krummels and Heath clings showed a total of 816 larvae on the trees and on the ground under them, as compared with 4 larvae on and under 9 Elbertas.

A DESCRIPTION OF THE IMMATURE STAGES OF *HIPPELATES PUSIO* LOEW AND A BRIEF ACCOUNT OF ITS LIFE HISTORY

By W. B. Herms[1] and R. W. Burgess[2]

Abstract

Contains a brief description with illustrations of the hitherto unknown immature stages of *Hippelates pusio*. The life history from egg to imago requires about three weeks as bred out in the laboratory at Coachella, California.

During the past several years the Hippelates fly problem of the Coachella Valley (California) has been becoming more and more acute and has lately been attracting nation-wide attention (Science Supplement, March 1, 1929, p. xiv). Not only is this persistent gnat believed to be an effective vector of conjunctivitis or pink eye (Schneider 1927), but because of its annoying habits it also seriously hampers laborers in the field, hand pollination of dates and the picking of fruit are made particularly difficult. Mr. E. P. Carr of Thermal, under date of March 18, 1929, writes, "We have had a serious epidemic of trachoma and conjunctivitis this year and now have two special nurses and a special health deputy at work cleaning up eye conditions in our schools. This brings home the Hippelates problem all the nearer." The Hippelates fly is truly a most trying pest.

The senior author first began a study of this problem in June 1926 (Herms 1926) from which time at intervals during the summers of 1926, 1927 and 1928 various members of the staff of the Division of Entomology and Parasitology of the University of California as well as certain student assistants were in residence at Coachella for short periods of time for the purpose of discovering the breeding habits of this insect. As the work progressed it became obvious that we were dealing with a baffling problem which required a more intensive and persistent campaign, hence in March of 1928 an abatement district was organized, the tax proceeds of which made it possible to build a small laboratory at Coachella and provide a resident entomologist (see Herms 1928). Mr. Robert W. Burgess, then Assistant in Entomology and Parasitology in the University of California, was put in charge of this work beginning January 1, 1929, having had some experience with the problem during the previous summer.

Under date of March 8, 1929, Mr. F. C. Bishopp, Principal Entomologist in Charge, Insects Affecting Man and Animals, U. S. Bureau of

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[2]Entomologist, Coachella Valley (Calif.) Abatement District, Coachella.

Entomology, wrote as follows (in a letter to the senior author), "Perhaps you have been informed of the fact that the second deficiency bill passed by Congress a few days ago carried an item of $12,000 for investigational work relating to Hippelates. It seems that the officers of the Coachella Mosquito Abatement District, following a meeting called to discuss the Hippelates problem, presented a strong petition to General Lord, Director of the Budget, urging the provision of funds to enable the Bureau of Entomology to undertake an investigation of the Hippelates problem. This appeal made such an impression on the Budget that it recommended to the President the incorporation of the above mentioned item in the deficiency bill to provide for the work. According to tentative plans we are to take up the study from more or less of an interstate point of view....." On April 15 (1929) both Mr. Bishopp and Mr. D. C. Parman were in Berkeley and discussed with Herms the plan of cooperation. Mr. Parman then immediately took up his work with traps in the Coachella Valley where he had left it during the previous summer and with funds provided by Congress, Parman and Burgess built several dozen large canvas-covered cages (6 ft. long, 3 ft. wide and 1 foot high) and distributed these widely in the valley, under a variety of

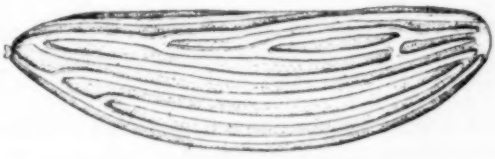

FIG. 55—Egg of *Hippelates pusio* (Greatly enlarged)

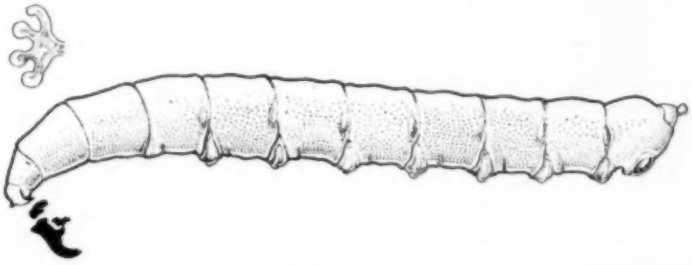

FIG. 56—Full grown larva of *Hippelates pusio*, showing also detail of anterior spiracular process and mouth hook (Greatly enlarged)

conditions. These cages were provided with a pint jar at each end for the purpose of trapping such insects as might emerge in the area covered by any particular cage. These jars are emptied once a week and the

contents examined. A letter from Mr. Burgess dated June 17, 1929 states that "..... fourteen or fifteen out of the forty cages have yielded Hippelates." Much of Mr. Burgess' time has been devoted to a search for the immature stages of the fly, continuing the laboratory experiments which had been started by Herms during the summer of 1926.

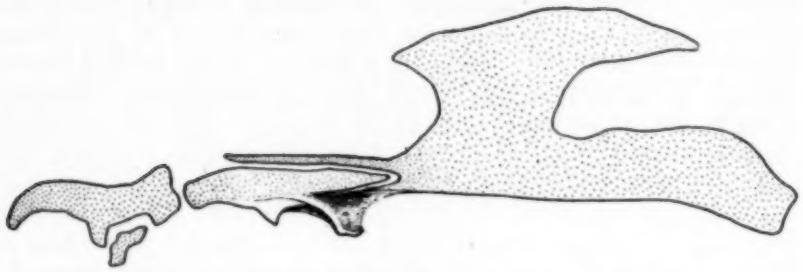

FIG. 57—Entire cephalopharyngeal skeleton of *Hippelates pusio* (Greatly enlarged)

Knowledge of the general appearance of the eggs of *Hippelates pusio* was secured during the summer of 1926 by dissecting gravid female gnats, but eggs actually oviposited by this species were not seen until about the middle of May of this year (1929) and these were discovered by Mr. Burgess in a pint fruit jar containing, together with trapped

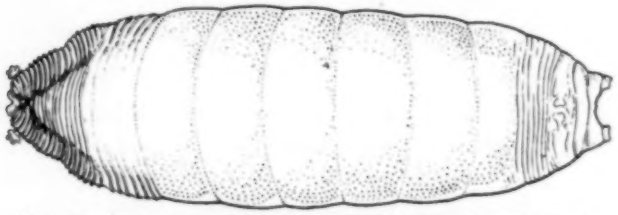

FIG. 58—Puparium of *Hippelates pusio* (Greatly enlarged)

living gnats, "water soaked shredded brown fibre from corrugated cardboard packing cases." Since that time eggs which are deposited singly have been secured repeatedly in jars with water soaked wheat straw and chaff as well as the brown paper. Immature stages have as yet not been taken under field conditions. The entire life history in the laboratory with the temperature ranging from 80° to 105° F. required about three weeks.

Description of Stages

Egg—The eggs are pearly white, measuring about .5 mm. in length. They are subcircular in cross section, prominently curved at one side and nearly straight on the opposite side. There is a prominent cap over the micropyle. The surface bears many fine longitudinal ridges often forming junctions (See Fig. 55).

Larva—The full-grown larvae average about 3 mm. in length. They are whitish (opalescent) in color, gradually turning brown in alcohol, rather pointed anteriorly and truncate posteriorly. A pair of very minute ocular tubercles are present. The anterior spiracular processes, also minute, consist of four spiracular papillae in a vertical row (Fig. 56, detail). The mouth hooks (Fig. 56) are gently curved. The entire cephalopharyngeal skeleton of the mature larva is shown in Figure 57.

Puparium—The puparium averages about 2.25 mm. in length. It is light straw color at first, turning chestnut brown as it grows older. The anterior spiracles of the larva can be easily seen (Fig. 58).

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MEXICAN SUGAR CANE-BORERS AND THE PARASITE *TRICHOGRAMMA*

By Stanley E. Flanders, *Citrus Experiment Station, Riverside, Calif.*

The Haciendas de Redo y Cia, situated south-west of Culiacan in the state of Sinaloa, include one of the most extensive sugar plantations on the West Coast of Mexico. Approximately 10,000 acres are planted to cane. The soil and climate are optimum for the growing of sugar cane but an inadequate water supply creates conditions very favorable for the development of certain cane pests. Within the past few years the depredations of the borers have reached a severity seldom attained elsewhere. In 1929 the writer was employed during February, March, and April to establish a biological control laboratory and to make a preliminary survey of the borer situation.

At least three species of borers were found to be responsible for the injury to the cane, *Chilo loftini* and two species of *Diatraea*. A more or

less general survey showed that about 97 per cent of the stalks and 25 per cent of the joints were attacked. The activity of these insects results in the killing of the cane in the field, reduction of the amount of sucrose in the cane, and an increase of fabrication costs due to poor quality cane juices. The annual loss is exceedingly high.

Chilo loftini is the most uniformly distributed and the most numerous of the three species of borers. From the standpoint of fabrication it is the most serious since it opens so many "portals of entry" for the sucrose-reducing fungus, *Colletotrichum falcatum*. This "red rot" fungus is so abundant that the crushed cane after passing through the first set of rollers at the mill appears splotched with red.

About 75 per cent of the infestation in the joints is attributable to *Chilo*. The factors that enable it to become so numerous are its continuous breeding throughout the year in large grasses, corn and cane, the protection of its eggs from parasitism by oviposition in crevices, as between the leaf sheath and the stalk, and an optimum environment in cane grown under insufficient moisture conditions.

It attacks the more fibrous and lignified parts of the cane, such as the rind and the nodes. Small, transverse tunneling characterizes its work. The larva in its latter instars is whitish with four longitudinal broken lines of purple-red. When full grown it is nearly an inch in length. The adult is straw-colored, resembling *Diatraea* but much smaller and less robust. The eggs are irregularly globular, slightly yellow and approximately 0.5 mm. in diameter.

From *Chilo* material taken from heavily infested cane the writer reared six specimens of *Chelonus* spp. From two *Chelonus* cocoons the larva of a hyperparasite was obtained. Fifteen specimens of a reddish Ichneumonid which attacks the full grown larva and the pupa were also reared. This parasite spins a silken cocoon and pupates between the remains of its host and the exit of the tunnel. The adult parasite emerges from the opening prepared by the larva for its own emergence as an adult. Although *Trichogramma* readily attacks the eggs of *Chilo* in the laboratory it is not likely that parasitism occurs to any extent in the field, since most of the eggs are probably deposited in crevices.

The species of *Diatraea* appear to be somewhat variable in distribution. It is probably responsible for about 25 per cent of the infestation in the joints. It also prepares the way for the invasion of the "red rot" fungus but its importance is mainly due to its killing of the young cane. *Diatraea* attacks the more succulent parts of the plant such as the "growing points" and internodes. The more vigorous succulent cane is

most highly infested since the adult females are attracted to dense stands. The cane is attacked only during the warm, humid months when growth is rapid.

The characteristic work of *Diatraea* in young cane is the formation of "dead hearts." In such cases a single borer causes the death of the plant. In old cane the tunnels extend lengthwise of the stalk and are about the diameter of a lead pencil.

.The larva is usually whitish with transverse rows of black spots. The color of the adult varies from dusky gray to straw color. There are probably three generations a year. The adults appear in the spring about the middle of May.

The eggs are disc-shaped and overlap like shingles. They are deposited on the leaf surface near the midrib. One species deposits its eggs singly or in small masses of eight or less. The other species deposits large eggs in large masses. A female of the latter species in confinement deposited 440 eggs in two successive evenings. These eggs measured 1.5 mm. in length.

In the field both large and small species are parasitized by *Trichogramma minutum*. The mortality of *Trichogramma* in eggs of the large species, however, is very high. According to a report submitted by Mr. T. Vogliotti, parasitized eggs of this species rarely yield any adult *Trichogramma*.

In August 1929 the effect on *Diatraea* of liberating several million *Trichogramma* in the cane fields was observed by T. Vogliotti to be as follows:

In colonized fields—

435 eggs of large borer were 24.2 per cent parasitized.

444 eggs of small borer were 63.2 per cent parasitized.

In uncolonized fields—

289 eggs of large borer were 7.1 per cent parasitized.

177 eggs of small borer were 30.3 per cent parasitized.

No attempt was made to determine variations of the natural parasitism in uncolonized fields so no definite data on the effect of the liberation were obtained.

The leaf-surface area in a stand of sugar cane is many times greater than the land area occupied. *Trichogramma* must cover the leaf surface to find its host. To colonize it early in the season when moth eggs are comparatively scarce is useless. When the host eggs are fairly abundant as in the latter part of June and the natural parasitism is 1 per cent or more, the natural accretion over a large area is not likely to be affected

by the addition of more parasites. A possible means of initiating an earlier building up of the parasite population is the colonization of *Trichogramma* at egg concentration points during May and the first part of June. A series of strong lights or baits placed at intervals throughout the planting should result in heavy egg deposition in the vicinity of each attractant. Advantage could be taken of this phenomenon to colonize *Trichogramma* at such focal points and establish a more uniform parasitism throughout the planting, possibly earlier than normally occurs.

The only other parasite of *Diatraea* noted was a dexiid fly, the puparia of which was found in several canes. The old burrows of *Diatraea* are often used as nesting places by a green bee, *Augochlora aztica* (Vachal).

Upon completion of the laboratory, February 20th, production of *Trichogramma* was started. A great quantity of corn, shelled and on the ear, stored in the company's warehouse was found to be heavily infested with *Sitotroga cerealella*. The burlap method[1] was used in the collection of the moths. The initial stock of *Trichogramma* was obtained late in February from the eggs of the milkweed butterfly *Danaus menippe*. By the first of April the stock on hand amounted to 75,000.

A quantity of corn in the laboratory happened to be heavily infested with *Ephestia cautella* so its eggs were tested for use in mass production. They did not prove suitable although *Trichogramma* showed a marked preference for them in the presence of *Sitotroga* eggs.

The longevity of the adults developing on *Ephestia* eggs was considerably shorter than those reared on *Sitotroga* eggs. If any *Ephestia* eggs remain unparasitized, the larva from them feed on the surrounding eggs and spin a mass of webbing over the entire surface.

The shortest period of development from egg to adult was six days at temperatures from 80° to 90° F. and at an average humidity of about 75 per cent. This is a more rapid development than that obtained by the writer in 1928 at Saticoy using the California strain of *Trichogramma*. A series of generations was started with three females and at the end of seven weeks the progeny, composing the sixth generation, amounted to about 300,000. This multiplication was cut short because the supply of host eggs was inadequate.

On the West Coast of Mexico the control of cane-borers by the use of the native strain of *Trichogramma* does not appear probable since the two most destructive species are apparently not attacked to any extent. The utilization of *Trichogramma minutum* for the control of the sugar cane borer in Louisiana apparently has a greater chance of success.

[1]See page 601, Journal of Economic Entomology, Vol. 22, 1929.

THE PRESENCE IN GEORGIA OF *BRACON MELLITOR* SAY, A PARASITE OF THE COTTON BOLL-WEEVIL

By JULIAN H. MILLER and GEORGE F. CRISFIELD, *University of Georgia*

ABSTRACT

The weevil parasite, ***Bracon mellitor***, has appeared this year in cotton fields in all parts of this State investigated. The first of these braconids were found in June, and then continuously until Sept. 15, when the work was temporarily halted. The number of weevil larvae destroyed in this manner ran as high as 18% in bolls and 35% in hanging squares in August in the field which was under constant observation.

This minute wasp, ***Bracon mellitor***, has been reported by Hunter and Pierce[1] as occurring extensively in Texas and Oklahoma. There it has been found to have the same general distribution as the weevil, and until 1909 it was considered the most important parasite. It has been recorded from three species of Lepidoptera and from seven species of Curculionidae.

The parasite was first discovered in a cotton field near Athens, and later was found in quantity as far south as Waynesboro and as far north as Cornelia. The field near Athens has been under observation by the writers from the middle of May until September 15th. Cotton bolls and squares containing weevil larvae were picked from day to day, and the number of larvae parasitized were recorded. The habits of the Bracon were studied in the laboratory.

Cotton bolls and squares were placed under tumblers in contact with the Bracon wasps. The parasite made many attempts to penetrate the bolls and squares with its ovipositor, but was unsuccessful except where it encountered the weevil puncture. It deposits an egg in the cavity beside the weevil, and this hatches out within 3 to 6 days and the very young Bracon begins feeding. The weevil larva is completely destroyed within 9 to 12 days, and the wasp emerges as an adult in about 5 to 8 days more. The time for the complete life cycle varies with the season. In mid summer it is from 10 to 18 days, about 25 days in June, and much longer in the fall. The egg-hatching period has been continuous over the time of this study.

The activities of the parasite result in no harmful effect on the plants. No scars were observed on bolls placed under tumblers containing the parasite. With its ovipositor it penetrates only the weevil puncture.

[1]1912. W. D. Hunter and W. D. Pierce. The Mexican Cotton Boll-weevil: A Summary of the Results of the Investigation of this Insect up to December 31, 1911. Senate Document vol. 8, no. 305, p. 142.

In this field the cotton was dusted four times and the fallen squares were picked up, and still the writers were able to find large numbers of weevils during the entire period. The rainfall was heavy in June and July, but August was very dry with high temperatures. During the latter month many weevil larvae died in the squares due to the hot dry weather.

During June an average of 10% of the weevil larvae in the bolls and squares were parasitized, in July 14%, and in August and the first part of September about 18% in bolls and 35% in squares hanging on the plants. The per cent of parasitism was found to be greater in bolls and squares on the plant than in fallen ones during the entire period. The adult parasites were found chiefly around the top of the cotton plant.

The writers are experimenting with a method of breeding the parasites, and are also attempting to discover the conditions of hibernation in nature.

This Bracon parasite seems to be the most important one in Georgia. The present rate of weevil destruction from this source is of considerable value, but it is probable that it could be materially increased by breeding and distributing them.

NAPHTHALENE FUMIGATION AT CONTROLLED CONCENTRATIONS[1, 2]

By ALBERT HARTZELL and FRANK WILCOXON

ABSTRACT

A method of maintaining a constant concentration of naphthalene is described as an improvement on former methods of fumigation with this substance. A concentration of 0.008 lbs. of naphthalene per 1000 cu. ft. of air maintained for eight hours was found to kill red spider mite (*Tetranychus telarius*), cyclamen mite (*Tarsonemus pallidus*), the onion thrips (*Thrips tabaci*), and the black grain thrips (*Heliothrips femoralis*) without injury to a number of plants that have proved intolerant to methods used previously.

INTRODUCTION

With the increased use of naphthalene as a greenhouse fumigant for the control of mites and thrips the question of a suitable method of volatilizing this material has arisen. Among the methods employed are broadcasting along the borders (9), volatilization with a lamp (4, 6), and finally the substitution of an electric hot plate (5). The importance

[1]Contributions from the Boyce Thompson Institute for Plant Research, Inc., Yonkers, New York, published at the expense of the Institute out of the order determined by the date of receipt of the manuscript.

[2]Herman Frasch Foundation for Research in Agricultural Chemistry Paper No. 4.

of maintaining a slow uniform rate of volatilization has been stressed by all investigators. Volatilization by means of lamps or electric hot plates has proved satisfactory for the more tolerant species and varieties, but certain plants are injured (5) by naphthalene vapor when these methods are used. The use of any method involving heat suffers under the disadvantage that a rather high concentration of naphthalene vapor is produced in the immediate neighborhood of the apparatus. This concentration will exceed the saturation value in parts of the greenhouse removed from the point of volatilization, and will cause deposition of naphthalene on the plants with consequent injury to those which are sensitive. If the naphthalene vapor could be introduced without heat, such a deposition would not occur, and injury would be reduced to a minimum. It would be necessary, of course, to supply the naphthalene vapor at a rate sufficient to compensate for leakage and to maintain the desired concentration for as many hours as were found needful for control. By passing a current of air over naphthalene at the same temperature as the greenhouse it should be possible to maintain almost any desired concentration up to that corresponding to the sublimation pressure of naphthalene, which would be the maximum attainable.

The Apparatus

In order to meet the requirements as outlined above, a naphthalene saturator was constructed in the form of an air tight rectangular metal box, 47 in. long, 35 in. wide, and 35 in. high. This box (Fig. 59) was divided into four compartments by three vertical baffles, and each compartment contained eight horizontal shelves. Air was drawn in at one end of the box, and travelled through each compartment in succession and was expelled through an opening in the top of the box at the opposite end from the point of entry. A motor-driven blower mounted on the top of the box served to draw the air through the saturator and expel it into the fumigation chamber. The air in passing over the shelves, which were each filled with a single layer of naphthalene balls, became partially saturated with naphthalene vapor. The final concentration of naphthalene in the air at a given temperature could be controlled either by varying the number of shelves filled with naphthalene balls, or by varying the speed of the blower. In these experiments the speed of the blower was constant, 1144 R. P. M., and the first mentioned method of control was used. With 24 shelves filled (which required 79 lbs. of naphthalene), and with an air velocity of 52 cu. ft. per minute, the time of contact of the air with the naphthalene was

approximately one minute and the area of contact was approximately 12–1/3 sq. ft., assuming the naphthalene balls to be spheres of uniform size. The number of pounds of naphthalene balls required to give satisfactory control of mites and thrips without injury to the host plants was determined by trial. In general, satisfactory results were obtained with 79 lbs. When 64 lbs. were used the control of cyclamen mite was possible with a 12-hour fumigation, but rather unsatisfactory results were obtained with red spider mite. With 93 lbs. considerable injury to the plants was experienced.

A greenhouse compartment situated between two larger sections was used as a fumigation chamber (Plate 20, Fig. A). The capacity of this chamber was 850 cu. ft. The height and width of the compartment was the same as the adjacent greenhouse sections and differed only from them in being about one-seventh their length. As the compartment was a unit in the same greenhouse range, the conditions of temperature, humidity, and light intensity were comparable to those of the adjoining greenhouses.

The naphthalene saturator described above was installed in the chamber and naphthalene free air was drawn into the saturator from an adjacent greenhouse section by means of a duct. Upon completing its path the air ladened with naphthalene vapor was deflected upward from the exhaust of the blower into the fumigation chamber. Opposite the saturator was a shelf built the same height as the greenhouse benches on which potted plants to be fumigated were placed. In very cold weather it was sometimes found that a small amount of naphthalene condensed on the panes of glass that constituted the roof of the chamber. When this happened it was desirable to remove the deposit since condensing moisture ladened with naphthalene dropped on the plants and caused injury.

Fumigations were made both day and night. In this study special emphasis was laid on testing the tolerance of plants that previous investigation had shown to be sensitive to naphthalene vapor. These were carefully checked with plants of the same age that had not been fumigated in order to note any possible delayed effect that the fumigation might have on plant growth. Plants infested with mites and thrips were fumigated and the results compared with data on the natural mortality of these species. Daylight fumigations were begun at 10 A. M. and continued until 4 P. M., a period of six hours. If an eight-hour period was desired the fumigation was terminated at 6 P. M. Night fumigations were run for a period of 15 hours, beginning at

5 P. M. and continuing until 9 A. M. the following morning. The plants were watered before fumigation as previous experience had shown that plants fumigated under dry conditions were liable to be injured.

Analysis of Greenhouse Air For Naphthalene

In greenhouse fumigation experiments few attempts to determine the actual concentration of the active agent are on record. Eddy and Geddings (1) give data on the determination of hydrogen cyanide in a

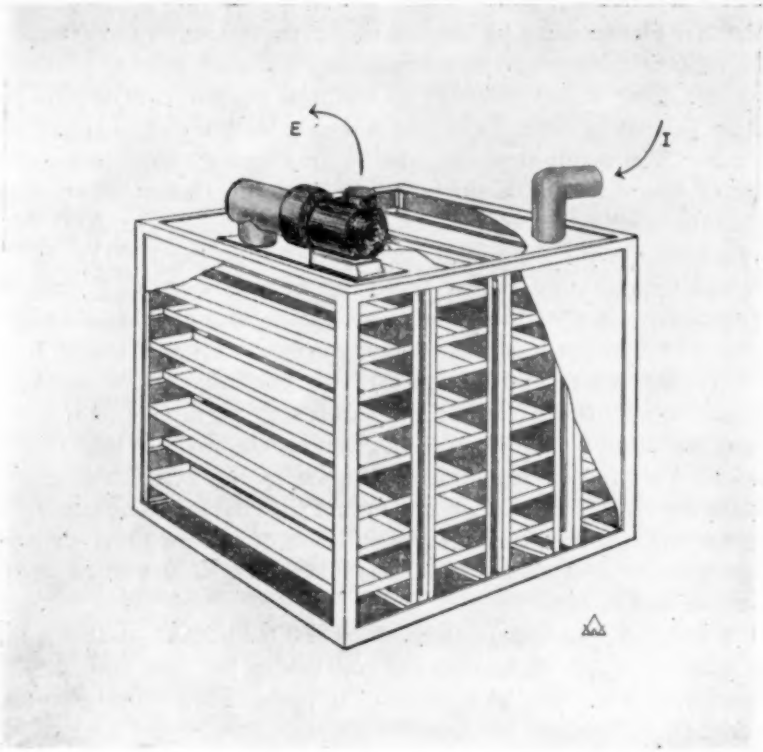


Fig. 59.—Naphthalene saturator consisting of a galvanized iron box containing 32 horizontal shelves separated by baffles. *I*. The naphthalene free air is drawn in at this point from an adjacent greenhouse section. *E*. The air ladened with naphthalene is expelled at this point from the motor-driven blower after its pasage over the shelves filled with a single layer of naphthalene balls.

fumigation chamber. It was considered desirable to attempt to determine the naphthalene concentration in the greenhouse air during a fumigation, although it was known that this was very small. The

method adopted was that of Gair (3). Air was drawn by a water pump through an absorption train consisting of two gas washing bottles each containing 175 cc. of acetic acid of sp. g. 1.044, followed by a third bottle containing 150 cc. of saturated picric acid solution. The air was finally passed through a small laboratory flow meter. At the conclusion of a run, the naphthalene was precipitated as the picrate by the addition of 500 cc. of saturated picric acid solution as described by Gair. The naphthalene picrate was filtered through a weighed Gooch crucible, dried in a desiccator and weighed. From the weight obtained, and the volume of air measured by the flow meter, the concentration of naphthalene vapor in the greenhouse air could be calculated. Owing to the small concentration, it was necessary to continue the run over several fumigation periods in order to obtain a weighable amount of naphthalene picrate. The result thus obtained is an average value, and required four or five days for a single determination. One such experiment gave a concentration of naphthalene of 0.0076 lbs. per 1000 cu. ft., and a subsequent determination gave 0.0085 lbs. per 1000 cu. ft. The average temperatures during these experiments were 86°F. and 89°F. respectively. A determination in which the sample was taken at the point of exit from the saturator gave a concentration of 0.0128 lbs. per 1000 cu. ft. Roark and Nelson (8) have published tables showing the amount of naphthalene vapor in saturated air at various temperatures. From the value for 86°F. which is given as 0.06 lbs. per 1000 cu. ft., it appears that in our experiments the air in the neighborhood of the plants was approximately 13% saturated with naphthalene vapor. This concentration if maintained for a sufficient length of time, gave satisfactory control of mites and thrips with less injury than previous methods had shown.

By weighing the charge of naphthalene before and after a series of fumigations it was found that the rate of loss per hour was 0.0884 lbs. This includes any loss that might take place between periods of fumigation.

Plant Tolerance

It has been shown in previous publications (4, 5) that certain species and varieties of plants are injured by the lamp and hot plate methods of volatilization. This was found to be true even with fumigations made at night and with amounts not exceeding two ounces per 1000 cu. ft. of greenhouse space. Of 150 species and varieties tested by the above methods more or less foliage injury resulted to forty-two. A list of these intolerant plants follows:

Capsicum annuum var. longum (pepper)
Fagopyrum esculentum (buckwheat)
Fuchsia speciosa
Glycine max (soy bean)
Linaria sp.
Lycopersicum esculentum (tomato)
Lythrum salicaria var. roseum
Magnolia sp.
Martynia proboscidea
Matricaria alba
Maurandia sp.
Nemesia sp.
Nemophilia sp.
Nicotiana langsdorffi
Nicotiana longiflora
Nicotiana nudicaulis
Nicotiana paniculata
Nicotiana plumbaginifolia
Nicotiana quadrivalvis
Nicotiana repanda
Nicotiana rustica
Nicotiana sanderae
Nicotiana suaveolens
Nicotiana sylvestris
Nicotiana tabacum
var. gigantia
var. purpurea
Nicotiana trigonophylla
Nycterinia capensis
Oxalis sp.
Papaver sp. (poppy)
Papaya sp.
Pelargonium sp. (geranium)
Plantago major (broad leafed plantain)
Philadelphus sp. (mock orange)
Physalis sp.
Raphanus sativus (radish)
Rose var. Button hole
Ribes nigrum (black currant)
Schizanthus wisetonensis
Trifolium pratense (red clover)
Tropaeolum majus (nasturtium)
Vitis vinifera (grape)

While it was not found feasible to test every species and variety in the above list with fumigations at controlled concentrations, it was found possible to test the more common species grown in greenhouses and in addition a number of important plants not included in the above list. Reference to Table 1 will show that of a total of 32 species and varieties of plants fumigated, only three species were found to be intolerant, namely buckwheat (*Fagopyrum esculentum*), soy bean (*Glycine max*), and Tabasco pepper (*Capsicum annuum* var. *conoides*). The last named plant was only slightly injured, the very oldest leaves turning yellow and falling off. Other varieties of pepper were uninjured. Seedling buckwheat plants were found to be by far the most sensitive of the three (Plate 21, Figs. A and B). A comparison of the above list of intolerant plants with Table 1 shows that of a dozen species and varieties which were found to be intolerant to naphthalene fumigation by the lamp and hot plate methods, only two were severely injured by our improved method. Included in these tests were such important greenhouse plants as pepper (*Capsicum annuum*) (five varieties), tomato (*Lycopersicum esculentum*), *Oxalis* sp., geranium (*Pelargonium* sp.), radish (*Raphanus sativus*), rose seedlings and nasturtium (*Tropaeolum majus*), which could not be fumigated with safety by the older methods, but which were found to be tolerant when fumigated at a properly

controlled concentration. Irish Cobbler, Green Mountain, and Bliss Triumph potatoes (*Solanum tuberosum*), egg-plant (*Solanum melongena* var. *esculentum*), turnip (*Brassica rapa*), *Bryophyllum* sp., *Calendula officinalis*, China aster (*Callistephus chinensis*), *Centaurea imperialis*, cucumber (*Cucumis sativus*), *Datura stramonium*, carrot (*Daucus carota* var. *sativa*), Sudan grass (*Holcus sudanensis*), Turkish tobacco (*Nicotiana tabacum*), bean (*Phaseolus vulgaris*), *Sedum* sp., white clover (*Trifolium repens*), and wheat (*Triticum aestivum*) were also found to be tolerant. Even cyclamen plants in flower were not injured (Plate 20, Figs. B and C). It should be noted that all these plants were fumigated in daylight at temperatures ranging from 72° F. to 100°F., during both cloudy and sunny weather and that no injury resulted even with concentrations slightly higher than that found necessary to kill mites and thrips. A careful comparison of fumigated plants with their corresponding check plants which were not fumigated, showed no evidence of stunting or of delayed injury.

The writers' previous experience had been unfavorable with daylight fumigations in bright sunlight and with the higher range of temperatures. Apparently the slower uniform rate of volatilization of naphthalene by this method results in a concentration considerably below the tolerance limit to foliage, which is in direct contrast to the uneven rate obtained by means of the hot plate and lamp methods with the resultant injury to foliage. The chief disadvantage of daylight fumigation is the difficulty of keeping the temperature from rising too high; this especially is true with plants such as cyclamen and potato which are normally grown at lower temperatures. It is interesting to note in this connection that a concentration which would injure young buckwheat plants but which would not injure six-inch tomato plants (var. Bonny Best) was found to be suitable for all species and varieties as shown in Table 1, with the exception of buckwheat, soy bean, and Tabasco pepper.

TABLE 1. EFFECT OF NAPHTHALENE FUMIGATION AT CONTROLLED CONCENTRATION ON HOST PLANTS

Name of Plant	Number of Plants	Height of Plants Inches	Daylight Fumigation 6 hours Temperature °F.	Daylight Fumigation 6 hours Relative Humidity Percent
Brassica rapa (turnip)	40	4	82–100	70
Bryophyllum sp	5	6	82–100	70
Calendula officinalis	5	6	78–90	67
Callistephus chinensis (China aster)	24	4	68–98	68
Capsicum annuum var. abbreviatus	36	12	82–100	70
var. acuminatum	36	10	82–100	70
var. cerasiforme (red cherry pepper)	36	8	82–100	70

TABLE 1—*Continued*

var. conoides (Tabasco pepper)*	36	15	82–100	70
var. fasciculatum (Red Japan cluster pepper)	36	12	82–100	70
var. grossum (bell pepper)	36	12	82–100	70
Centaurea imperialis	5	6	78–90	67
Cucumis sativus (cucumber)	10	4	86–100	48
Cyclamen indicum	15	10	80–100	50
Datura stramonium	30	12	80–100	78
Daucus carota var. sativa (carrot)	50	3	68–98	68
Fagopyrum esculentum (buckwheat)*	200	10	82–100	70
Fuchsia speciosa	5	15	78–90	67
Glycine max (soy bean)*	200	6	80–100	78
Holcus sudanensis (Sudan grass)	100	12	68–98	68
Lycopersicum esculentum (tomato)	50	6	76–86	68
Nicotiana tabacum	24	—	82–100	70
Oxalis sp	500	—	82–100	70
Pelargonium sp. (geranium)	5	12	78–90	67
Phaseolus vulgaris (bean)	10	—	72–	58
Physalis francheti	10	4	82–100	70
Prunus persica (peach)	10	24	80–84	56
Raphanus sativus (radish)	50	4	82–100	70
Rose seedlings	20	6	81–95	64
Sedum sp	5	6	76–96	50
Solanum melongena var. esculentum (egg-plant)	10	—	68–98	60
Solanum tuberosum var. Irish Cobbler potato	12	—	78–100	56
Solanum tuberosum var. Bliss Triumph	40	—	78–100	56
Trifolium pratense (red clover)	200	8	82–100	70
Trifolium repens (white clover)	200	4	82–100	70
Triticum aestivum (wheat)	100	4	80–100	50
Tropaeolum majus (nasturtium)	50	8	82–100	70
			Night fumigation 15 hours	
Capsicum annuum var. abbreviatus	36	6	72–80	78
var. acuminatum	36	6	72–80	78
var. cerasiforme (red cherry pepper)	36	6	72–80	78
var. conoides (Tabasco pepper)*	36	6	72–80	78
var. fasciculatum (Red Japan cluster pepper)	36	6	72–80	78
var. grossum (bell pepper)	36	6	72–80	78
Glycine max (soy bean)*	100	4	76–86	68
Lycopersicum esculentum (tomato)	24	18	72–80	78
Nicotiana tabacum (tobacco var. Turkish)	24	3	72–86	68
Oxalis sp	200	—	72–80	78
Trifolium pratense (red clover)	200	—	72–80	68

*Foliage injured.

CONTROL OF GREENHOUSE PESTS

It was found during the course of this investigation that naphthalene fumigation would control cyclamen mite (*Tarsonemus pallidus*) on various greenhouse plants such as cyclamen and pepper. The minimum

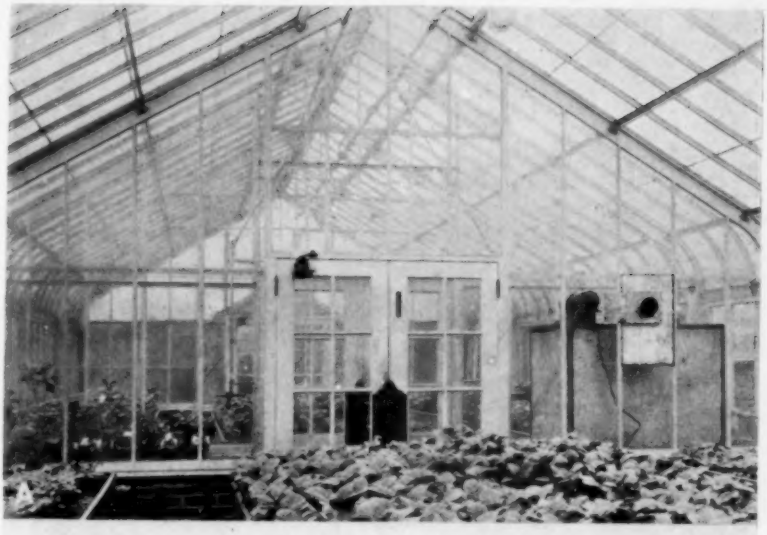
period of exposure necessary to obtain satisfactory control was found to be six hours when 79 lbs. of naphthalene was used in the saturator. It has been shown elsewhere (3) that the red spider mite[1] (*Tetranychus telarius*), the onion thrips (*Thrips tabaci*) and the black grain thrips (*Heliothrips femoralis*) are controlled by naphthalene fumigation. As indicated in Table 2, it required a minimum of eight hours to obtain a satisfactory control of thrips and of the red spider mite. Thus it follows that the three species could be controlled by eight-hour fumigations and if the plants were infested with the cyclamen mite alone, a six-hour fumigation was sufficient or the amount of naphthalene could be reduced to 64 lbs. and the period lengthened to 12 hours.

TABLE 2. PERCENTAGE CONTROL OF GREENHOUSE PESTS TO NAPHTHALENE VAPOR

				Red Spider mite		Cyclamen mite		Thrips			
								Thrips tabaci		Heliothrips femoralis	
Exposure to naphthalene vapor	Temperature			Number of specimens	Per cent control	Number of specimens	Per cent control	Number of specimens	Per cent control	Number of specimens	Per cent control
Hours	Maximum °F.	Minimum °F.	Relative humidity Per cent								
6	84	80	56	—	—	500	100	200	100	500	96.1
6	100	78	46	171	74	500	100	—	—	—	—
8	100	80	50	187	94.1	241	100	—	—	—	—
8	100	80	63	267	99	500	98.6	—	—	—	—
8	100	78	70	525	97.3	—	—	—	—	—	—
8	75	74	72	393	94	500	99	502	99	500	99

The question of the resistance of the various stages of the red spider mite to naphthalene vapor has arisen. Read (8) has shown by laboratory experiments that it required at least eight hours' exposure of the eggs to a saturated atmosphere of naphthalene to prevent hatching; at 60°F. they were not killed when exposed for a period of 30 hours. To determine the effect of this method of fumigation on hatching of eggs, leaves from plants fumigated for eight hours at an average temperature of 86°F. were placed in petri dishes and counts of larvae (first stage) made at various intervals of time. A similar series of leaves from unfumigated plants served as a check. Table 3 shows the number of larvae on these leaves in the control and fumigated series. The temperature during this period was 71°F. It will be observed that fumigation by this method has had a considerable effect on the hatching of the eggs. In the control 21% of the eggs had hatched after 120 hours while in the case of the fumigated series only about 3.5% had hatched in this time.

[1]The term red spider mite is used in preference to the term red spider, following the suggestion of the Committee on Nomenclature of the American Association of Economic Entomologists.



A. Fumigation chamber situated between two greenhouse sections with naphthalene saturator in place. Note the plants to the left to be fumigated.

B. Cyclamen plants in flower that have been fumigated with naphthalene showing no injury to flowers or foliage.

C. Cyclamen plants that were badly infested with cyclamen mite that have been fumigated with naphthalene with no foliage injury.

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A. Buckwheat plants unfumigated.

B. Buckwheat plants that have been fumigated with naphthalene showing foliage injury. Buckwheat is very intolerant to naphthalene fumigation and was found to be one of a few plants unsuitable for fumigation with naphthalene.

TABLE 3. EFFECT OF NAPHTHALENE FUMIGATION ON HATCHING OF EGGS OF RED SPIDER MITE

Hours After Fumigation	Fumigated		Control	
	Number of eggs	Number of Larvae (First Stage)	Number of Eggs	Number of Larvae (First Stage)
24	964	11	394	16
48	—	20	—	20
72	—	30	—	72
120	—	34	—	84

A study of the comparative resistance of the larva, protonymph, deutonymph, and the adult female to naphthalene vapor showed that there was a slight increase in resistance on passing from the larva to the adult and, furthermore, that the last two stages exhibit a significant difference in resistance when compared with the first two stages. When the X^2 test for homogeneity (2) was applied to the data on the first and second stages grouped together as compared with the third and adult stages grouped similarly, the difference was found to be significant with odds greater than 100 to 1. The total number of individuals used in this comparison was 4204.

The possibility of recovery of the red spider mite after fumigation was considered. To test this point leaves from fumigated plants were kept in petri dishes under observation for a period of 120 hours and counts of living individuals exclusive of the eggs and first stages, were made. Out of a total of 380 individuals 15 were alive 24 hours after fumigation and 11, 120 hours after fumigation. It appears, therefore, that the percent recovery in the 120 hours following an eight-hour fumigation was very low, while the mortality in the check was less than two percent.

DISCUSSION

In the case of a toxic agent, where the concentration necessary to kill is not far removed from that which will injure the host plant, it is desirable to use the material at a constant concentration. If the concentration fluctuates widely during the experiment, injury may be experienced, even though control is incomplete. Naphthalene as a fumigant seems to be a case of this kind. The method of fumigation described in this paper provides an almost automatic control of the actual concentration, and also permits an experimental determination of the best time and concentration to use for a given purpose. The fact that by this method it was possible to fumigate plants that had previously proved intolerant to naphthalene, suggests that a more careful study of compounds already in use may be as valuable as a search for new toxic agents hitherto untried. The writers' experience with naphthalene as a

greenhouse fumigant as applied by the hot plate and lamp methods has not been entirely satisfactory with mixed plantings. The difficulty of removing intolerant plants prior to fumigation greatly limits its use. The method described above has not yet been tested for large scale use but the principle involved, i.e., the use of a constant concentration of naphthalene throughout the fumigation period appears to be a step in the right direction.

Summary

A method of fumigating with naphthalene is described which permits a constant concentration of naphthalene to be maintained in the fumigation chamber throughout the experiment.

It has been established that a concentration of naphthalene 0.008 lbs. per 1000 cu. ft. if maintained for eight hours at an average temperature of 87°F. and an average relative humidity of 60% will give satisfactory control of the red spider mite, cyclamen mite, and thrips.

No injury was observed in these experiments to any plant except buckwheat, soy bean, and one variety of pepper. Fumigation was carried out in the daytime as readily as at night by this method.

A series of plants that had proved intolerant to naphthalene fumigation by previous methods was successfully fumigated by the method described.

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THE COMPARATIVE INSECTICIDAL VALUE OF DIFFERENT SPECIES OF DERRIS[1]

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ABSTRACT

A comparison of the insecticidal values of extracts and powders made from identified species of the genus *Derris*, in which all were found valuable.

The insecticidal value of various tropical plants belonging to the genus *Derris* (family Papilionaceae, tribe Dalbergieae, subtribe Lonchoecarpinae) is the subject of certain recent papers. With few exceptions, no attempt is made to identify specifically the plants used in the reported experimentation. McIndoo, Sievers and Abbott (1)[3] used some half-dozen species, and in the end find that only *D. elliptica* (Roxb.) Benth. and *D. uliginosa* Benth. are "satisfactory for insecticidal purposes." But, while they employed in much of their work their own macerations of "tuba," or "toeba," received from Java as roots of *elliptica*, many of their data are derived from the use of a fine powder obtained in Malayan market places,—the ground root of a species described as "probably *D. elliptica*." Wells, Bishopp and Laake (2 p. 91) state that the material used "is supposed to be from *Deguelia* (*Derris*) *elliptica*." The material used by Tattersfield and Roach (3) is the same as that reported upon by Fryer, Stenton, Tattersfield and Roach which is stated (4 p. 22) to be "commercial samples of *Derris elliptica*." The material used by deOng and White (5) was also a commercial sample. Since species determination by such an authority as E. D. Merrill was made possible

[1]The following list of synonyms is taken from Merrill's "Enumeration of Philippine Flowering Plants. 2:299–302. 1923

Derris elliptica Roxb.	*Derris heptaphylla* (Linn.) Merr.	*Derris trifoliata* Lour.
Galedupa elliptica Roxb.	*Sophora heptaphylla* Linn.	*Robinia uliginosa* Roxb.
Galactia terminaliflora Blanco	*Pongamia sinuata* Wall.	*Dalbergia heterophylla* Willd.
Cylista piscatoria Blanco	*Pterocarpus diadelphus* Blanco	*Galedupa uliginosa* Roxb.
Millettia splendidissima Vidal	*Derris sinuata* Thwaites	*Pongamia uliginosa* DC.
Millettia piscatoria Merr.	*Derris thyrsiflora* F.-Vill.	*Pterocarpus frutescens* Blanco
	Derris floribunda Naves	*Derris uliginosa* Benth.
	Derris diadelpha Merr.	*Derris diadelphus* Naves

[2]The following data were secured in experiments performed at the University of California but prepared for publication after the author had resigned from this institution.

[3]Reference is made by number (italic) to "Literature Cited."

only by the aid of foliage in addition to roots and stems, it would seem that doubt might be cast on the determination of commercial supplies and possibly some of the variations reported by certain investigators might be due to this cause. With the most generous recognition, therefore, of the research of different workers, it has nevertheless appeared desirable to pursue inquiry further in the light of accurate identification of all the species of Derris used, without exception. To this additional investigation there is an increased incentive in the fact that several species of Derris grow commonly in the Philippine Islands, where they are highly available both for export as raw material and for local manufacture into exportable insecticides.

That the writer has had peculiar opportunity for such study of Derris is due to the encouragement of E. D. Merrill, Dean of the College of Agriculture, University of California, late Director of the Bureau of Science at Manila and a foremost authority on the botany of the Philippine and Malayan islands. Through Dean Merrill's assistance, specimens of four species of *Derris* were obtained from the Bureau of Forestry of the Philippine Islands, identified, and tested for insecticidal value. These species are *Derris elliptica* (Roxb.) Benth., *D. heptaphylla* (Linn.) Merr. (*D. sinuata* Thw.), *D. polyantha* Perk., and *D. trifoliata* Lour. (*D. uliginosa* Roxb.). The experimental material was collected through the immediate kindness of Arthur F. Fischer, Director of Forestry, Manila, P. I., and shipped to Berkeley, California. No attempt was made to preserve the insecticidal principle in transit or storage, the specimens being baled and shipped in rough packages. The cut ends of the twigs, upon arrival frequently showed a white gummy exudate, presumably the dried sap.

From the four species on hand, preparations were made in the form of ether extract (obtained by use of a Soxhlet extractor) of water and alcoholic extracts, and of finely ground powder made direct from the dry raw material. With these, insecticidal tests were made as detailed below. In certain experiments, as indicated, the insecticide used had been prepared from roots; in others, from stems; in others, from trunks.[4]

[4]A study of insecticidal values given in the appended records reveals a much lower toxicity than that claimed for the roots of *D. elliptica* as a fish poison. An unpublished report of the Philippine Forest School Notes, loaned by H. E. Woodworth, formerly Professor of Entomology, College of Agriculture, University of the Philippines, states: "*D. elliptica* ('tuba') roots are tied into bundles of convenient size and length which are then crushed at one end and dipped into the water. The soapy substance given off poisons the fish at dilutions of 1 to 350,000 or 500,000. The toxicity may be increased by placing the roots in the mud several days before using." Such a report leads to the thought that the toxicity of the material may be impaired by drying and by time used in shipping, and that a more toxic extract might be obtained from the fresh material.

EXTRACTION METHODS (3). Sections of the root (or trunk, or stem) of a given species were ground in a mill and extracted in a Soxhlet extractor on a water bath. After three to four hours of extraction, the ether was removed from the apparatus and placed in a flask connected to a condenser and receiving flask. Most of the ether was then distilled off (again on a water bath), a residue of 15–20 cc. being left. (The bath method is used to prevent decomposition of the Derris extract, which takes place at rather low temperatures.) This residue together with the rinsings obtained from the emptied flask with fresh ether, was now evaporated on a water bath, while being constantly stirred. The beaker was removed when the temperature reached 60° C. or when no more bubbles were evolved on stirring. On cooling, the dark green liquid or extract solidified, permitting its amount to be determined as tabulated below. This done, the extract was remelted by immersion of the beaker in hot water, at which time sufficient pyridine or alcohol was added to prevent solidification during the process of cooling. Thus liquefied, it was diluted as desired. It was possible to use less pyridine or alcohol by adding, to the melting extract, a small quantity of a sodium oleate soap, which addition is likely to be necessary if the extract on precipitating tends to clot.

The extracts as tabulated below were made from air-dry specimens which were ground as required, and the percentages as given in Table 1 were based on the weights of the air-dry specimens. These percentages would probably have been higher if an extraction period longer than three to four hours had been allowed, or if more finely ground material had been used.

TABLE 1. ETHER EXTRACTS FROM *Derris* SPP.

Species	Amount of Sample Used *Gm.*	Extract *Gm.*	Per cent Extract
D. elliptica roots	18.249	.343	1.87
trunk	23.670	.536	2.26
D. heptaphyllata roots	17.137	.717	4.18
D. polyantha roots	21.708	.687	3.17
trunk	16.755	.498	2.97
D. trifolia roots	17.803	.415	2.23
trunk	21.571	.703	3.26

INSECTICIDAL TESTS. The solidified extract was dissolved both in pyridine and alcohol. These solutions were then diluted in the ratio of 98 per cent of water to 2 per cent of the original extract. The derris extract in the pyridine solution precipitates to a certain extent when dissolved in water. The alcoholic solution would clot when diluted with water unless a small amount of a sodium oleate soap were added.

Small dishes were filled with the diluted extract, and beetles (*Hippodamia convergens* Guerin) immersed in the solutions. Every ten minutes those that showed no activity were removed. The individuals in which no signs of life appeared before the next ten minutes had elapsed, were considered dead. The checks consisted of pyridine and alcohol solutions of approximately the same concentration as that of the extracts.

Tables 2 and 3 give the rate of mortality on beetles for varying concentrations of *Derris trifoliata* and *D. polyantha*. The solidified ether extract of the species concerned was dissolved in ethyl alcohol containing approximately ½ per cent of a sodium oleate soap. Finding that it was possible to kill the beetles at low concentrations of the extract, a second series was run as shown in Table 3. Pyridine solutions of these same extracts were tried but at 0.10 per cent concentration no difference could be distinguished between the checks and the extracts, hence it was concluded that the alcoholic solution gave a more delicate indication of the insecticidal value of the species being tested.

Specimens of the roots of *Derris trifoliata*, *D. polyantha*, *D. heptaphylla*, and *D. elliptica* were ground very fine and the dust applied to rose aphid, *Myzus rosarum* Walker, with results as shown in Table 4. Ground sections of the stems of these four species were then applied pure to the woolly apple aphis, *Eriosoma lanigera* (Hausm.), and after thirty days' exposure it was found that *D. elliptica* and *D. trifoliata* had killed 100 per cent, with 55 per cent mortality for *D. heptaphylla*, and 84 per cent for *D. polyantha*, the check having a natural mortality of 48 per cent.

TABLE 2. TOXICITY TO BEETLES OF EXTRACTS FROM *D. trifoliata* (TRUNK) AND *D. polyantha* (ROOTS)

Concentration of Extracts	Time in Minutes				
D. *trifoliata* (trunk)	20	30	40	90	150
%	%*	%	%	%	%
2.0	—	66	100	—	—
1.0	—	92	100	—	—
0.5	—	85	100	—	—
0.4	18	72	100	—	—
0.2	45	65	—	100	—
0.1	25	48	—	100	—
Check (Alcohol 95%)	15	—	44	—	91
D. polyantha (roots)					
0.4	70	100	—	—	—
0.2	20	100	—	—	—
0.1	10	30	60	100	—
Check (Alcohol 95%)	—	—	—	—	30

*Percentage dead.

TABLE 3. TOXICITY TO BEETLES OF EXTRACTS* FROM *D. elliptica* (TRUNK), *D. polyantha* (ROOTS), AND *D. trifoliata* (TRUNK)

Species	Time in Minutes														
	10 %**	15 %	20 %	30 %	35 %	45 %	55 %	65 %	75 %	85 %	95 %	105 %	115 %	125 %	135 %
D. elliptica.... (trunk)	5	16	21	26	42	53	53	74	84	95	100	—	—	—	—
D. polyantha... (roots)	5	5	5	5	10	20	29	43	43	72	91	100	—	—	—
D. trifoliata.... (trunk)	5	5	10	10	10	10	14	19	24	33	43	62	76	86	100
Check (Alcohol 95%)	5	5	5	5	5	5	5	10	10	15	29	29	33	33	33

*The concentration of the extracts used in this table was 0.1 per cent.
**Percentage dead.

TABLE 4. TOXICITY TO ROSE APHID* OF THE GROUND DUST** OF *Derris* SPP.

Species	Number of Insects Used	Percentage Dead %	Length of Exposure
D. trifoliata (roots).....	120	63	4 days
D. polyantha (root).....	137	70	4 days
D. heptaphylla (roots).....	131	92	4 days
D. elliptica (roots).....	111	86	4 days

**Myzus rosarum* Walker.
**These were very finely ground undiluted dusts of the species indicated.

TABLE 5. REPELLING AND TOXIC EFFECT OF EXTRACTS* FROM *Derris* SPP. ON THE CATERPILLAR, *Euphydryas chalcedona*

Species	Number of Larvae Used	Larvae Dead %	Larvae Pupated %	Amount of Foliage Eaten %	Remarks
D. elliptica.... (roots)	34	33	5	2	Unsprayed growing tip completely eaten.
D. polyantha (trunk)	20	15	35	5	
D. trifoliata (roots)	22	13	4	10	
D. heptaphylla (roots)	26	4	4	40	
Check	19	6	—	100	Leaves and part of stem consumed

*Solutions containing 2 per cent by weight of the ether extracts of the species indicated.

Extracts of *D. trifoliata*, *D. polyantha* and *D. heptaphylla* were made by soaking chips and coarse powder of the roots and trunks of the above species in water and 95 per cent ethyl alcohol. These extracts had no effect on rose aphis.

The repelling action of the ether extracts of *D. elliptica* (roots), *D. polyantha* (trunk), *D. trifoliata* (roots), and *D. heptaphylla* (roots) was then tried on varying ages of the larvae of the butterfly *Euphydryas*

chalcedona (Dbldy. & Hew.), Table 5. Solutions containing 2 per cent by weight of the extract from the species indicated were sprayed on the foliage and stems of *Scrofularia californica* (the common host of this insect) and as soon as it was dried the larvae were placed upon the twigs. Feeding ceased, in most instances, after a few attempts to consume the sprayed foliage. A small percentage of the caterpillars was killed and the more mature pupated. The larvae were confined with these twigs for eight days but there was no appreciable increase in feeding during this period except in one cage the growing tip was consumed. The unsprayed twigs, however, were almost entirely consumed during this period, not only the foliage but much of the stems being eaten. The repelling effect apparently lasted during the entire time that the cuttings could be kept alive in the laboratory.

CONCLUSIONS AND SUMMARY. Identified specimens of *Derris elliptica* Benth., *D. heptaphylla* Merr., *D. polyantha* Perk. and *D. trifoliata* Lour. were tested comparatively to determine their insecticidal values. Experiments were made with ether extracts of the respective species, dissolved both in alcohol and pyridine and with pure dusts made by grinding specimens of different parts of the plants.

All species of *Derris* tested showed sufficient insecticidal value to warrant commercial experimentation both with ether extracts and the ground powder. *Derris elliptica* showed a certain degree of superiority over the other species tested but not such as to warrant classifying the latter as inefficient. Valuable inherent insecticidal properties were found in all species tested (1) as toxic agents in immersion tests, (2) as aphidicides, and (3) as a repellent for a species of defoliating caterpillar. These toxic values were found to be present in all parts of the plants tested although in slightly varying amounts.

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THE RELATION OF EVAPORATION TO KILLING EFFICIENCY OF SOAP SOLUTIONS ON THE HARLEQUIN BUG AND OTHER INSECTS[1]

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ABSTRACT

Tests of various known contact insecticides on the harlequin bug, ***Murgantia histrionica***, brought out the fact that certain soap solutions are very effective but only under conditions of low evaporation. Further experiments under known rates of evaporation show that the efficiency of soap solution is indirectly proportional to the rate of evaporation. The addition of hygroscopic substances did not materially increase the effectiveness. Tests with several kinds of soap and two other species of insects show that the relationship is probably a general one.

A series of preliminary experiments which will not be detailed here revealed the fact that the harlequin bug is unusually resistant to all of the common contact insecticides. The technique finally adopted for testing various insecticides was to dip or spray a given number of bugs, usually ten, confined in a small wire screen cylinder. After the excess liquid was blown off the insects were retained in the cage for not more than a day to check up on the results. Untreated insects from the same lot were confined in a similar cage as a control.

With this method a 6% solution of resin fish oil soap killed a higher percentage of harlequin bugs than any of the common insecticides including a number of commercial brands of nicotine, derris, pyretherum, and miscible oils used at the highest concentration recommended for any insect. Combinations of the other materials with soap did not increase the effectiveness. If the soap solution was diluted by the addition of other spray materials, the effectiveness was reduced about in proportion to the concentration of soap.

Following this lead other kinds of soap were tried in the same way. By testing a series of commercial soaps obtained at a grocery store it was discovered that many of them were more effective for harlequin bug than the resin fish oil soap. The strength of solutions was reduced to 2%. As a general rule the white soaps proved better than the strong yellow soaps.

During the course of these experiments it became evident that results obtained on different days were conflicting, and the differences seemed too great to be accounted for as experimental error. A small field test was then made with a 2% solution of one of the more promising brands

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of soap. The test was made on a bright clear day when a good breeze was blowing. Contrary to expectations only a very small percentage of the insects were killed. Many of the insects that were thoroughly covered with the spray never stopped moving and others quickly recovered from any ill effects. The spray material used had been giving nearly 100% kill in the small cages in the laboratory.

The greatest difference in conditions in the two cases seemed to be that of evaporation. To test the effect of this factor insects were sprayed in cages and immediately afterward placed in the sunlight and wind on a window sill while other lots were placed in a moist chamber at nearly the same temperature. The difference in results was striking. When insects were confined in the moist chamber a higher percentage was killed than with twice or even four times the concentration of the same kind of soap on insects which were quickly dried in the sunlight and wind.

Harlequin bugs that have survived a treatment of fairly strong soap solution by having it quickly evaporated, may be killed later by a quick dip or spray of water and subsequent confinement to a moist chamber. Unsprayed insects remained alive for several days in a moist chamber.

An attempt was then made to test the effect of a soap solution in air of known humidity by confining the sprayed harlequin bugs in jars over dry calcium chloride, sulphuric acid and concentrated salt solutions. This method was quickly abandoned because it soon became evident that extremely dry air in a confined space did not give as rapid a rate of evaporation as moving air of much greater humidity.

An apparatus was then set up to obtain atmometer records of evaporation for short periods of time. A potometer used by plant physiologists for measuring the rate of water loss from plants, was adapted to this purpose by fitting an atmometer bulb into the place usually occupied by a plant. Water is drawn through a horizontal tube graduated to hundredths of a milliliter. When readings are made air is admitted in place of water and its progress through the tube is timed. The atmometer bulb was enclosed in a wire cage similar to those used for confining the insects. Evaporation rate was varied artificially by means of a large electric fan. Insects to be tested were confined in a cage and dipped for five seconds in the solution. The excess material was quickly blown away by mouth and the cage suspended near the atmometer bulb.

The following table gives the results from a two per cent solution of soap used under various rates of evaporation. Chrystal Cocoa soap made by the Palmolive-Peet Company was used, since it had proved to be one of the most effective and does not form a gel in a cold two per cent solution. The evaporation rate given is the average for the period under

observation in milliliters per minute for a standard atmometer bulb. Ten insects were used in each trial and the final effect, an hour or more after treatment, is given. It was found that with healthy insects no further effect would take place after the soap solution had dried and that a few would sometimes revive on longer standing.

Evaporation in cc. per minute	Temperature °F	Relative Humidity	Final Effect on Insects: Number Crawling	Able to Move Legs	Number Dead
.0033	80	72	–	–	10
.0057	72	60	–	–	10
.0065	81	64	–	–	10
.0078	90	—	–	–	10
.0090	80	63	1	–	9
.0090	87	57	3	–	7
.0098	87	57	1	–	9
.0123	82	63	4	–	6
.0131	77	87	3	2	5
.0148	80	72	1	2	7
.0164	80	72	–	–	10
.0164	80	72	1	–	9
.0184	80	63	5	2	3
.0205	86	—	3	1	6
.0205	72	60	4	–	6
.0230	87	57	3	–	7
.0246	80	63	6	2	2
.0361	82	63	6	2	2
.0385	86	—	7	–	3
.0410	81	64	10	–	—
.0574	91	—	9	1	—
.0722	87	57	8	2	—

By averaging the results for those tests under approximately the same evaporation rates we get what is probably a more accurate picture of relation between killing effect and evaporation.

Evaporation per Min.	Per cent Killed
.0 to .01 cc.	91.9
.01 to .02 cc.	66.6
.02 to .03 cc.	52.5
.03 to .04 cc.	25.
more than .04 cc.	0

The same brand of soap was tested on adult Colorado potato beetles in a two per cent solution and on a species of aphid from Lactuca in a one-half per cent solution to see whether it affected other insects in the same way. These tests were made only under very high and very low evaporation rates. The results are given in the following tables:

Colorado Potato Beetle, Adults

Evap. Rate in cc per min.	Temperature F.	After 45 Minutes: Crawling	Move Legs	Dead
.0071	90	2	3	5
.0615	90	8	1	1

Aphid from Lactuca

Evap. Rate	Temperature F.	Per cent Killed
.0131	86	97.2
.0640	86	68.8

Other brands of soap tested in the same way gave similar results, showing that this relationship of killing effect to evaporation is not peculiar to any one kind of soap.

A number of tests were then made to see if the evaporation of the soap film could be retarded by the addition of from two to five per cent of hygroscopic substances such as glycerine, diethylene glycol and triethanolamine. Tests were made under both high and low evaporation rates with plain soap solution as a control. The differences in results did not seem to be greater than experimental error.

Additional field tests on harlequin bug after the discovery of the evaporation relationship, showed that with suitable weather conditions a high percentage of insects hit by the spray were killed. Adults are much more resistant than nymphs, which could be killed with less than a two per cent solution. On extremely humid days with no wind the control is limited only by the ability to hit the insects with the spray. This is not difficult on young cabbages, or collards or on seeding rutabaga tops which furnish a good trap crop in the spring. On large close headed collards or cabbages it is difficult to hit more than 50 to 75 per cent of the insects.

The author at first concluded from these experiments that under conditions of low evaporation the soap solution formed a surface film over the spiracles and cut off the air supply for a sufficient length of time to kill the harlequin bugs. To test this theory adults were confined in small cages and submersed in water that had been previously boiled to exclude air bubbles. They became apparently dead in about the same time as bugs treated with soap at the same temperature. But the insects that had been under water twenty-five minutes, the longest time that any were submersed, all revived and were apparently uninjured by the treatment. It was evident that the soap solution must have some effect other than the mere exclusion of the air during the period that it remains liquid.

A study of the anatomy of the spiracles of the adult harlequin bug showed they are all equipped with closing devices. The thorax has two pairs of spiracles. The first lie in the conjunctiva between the pro- and mesosternum and have access to the air only through the close fitting movable contact between those segments. The second lie in cavities between the meso- and metasternum and have access to the air through narrow rigid slits. The spiracles also have slit-like openings and the anterior lips are movable like a trap door and governed by muscles within the body. If portions of the pro- and mesosternum are cut

away from the living insect the flaps can be observed to open and close at intervals of a few seconds.

The abdominal spiracles have small circular openings. Attached to one side of the expanded tracheal trunk just inside the body wall is a cone-shaped chitinous process. One side of the base of the cone is hinged to the edge of the spiracle ring. A muscle runs from the apex of the cone to the body wall on the opposite side of the spiracle so that when contracted the cone is raised to a position nearly perpendicular with the body wall and its base completely covers the spiracle opening. The various types of spiracles of the Hemiptera have been described and figured by H. Mammen.[2] In the nymphs of the harlequin bug all of the closing devices appear to be in a rudimentary condition and are probably not functional.

By gluing a harlequin bug ventral side up on a card the action of the spiracles could be watched under a binocular. When soap solution is applied to the abdominal spiracles with a brush they close almost immediately and remain so until the solution dries. No liquid seemed to enter them and no air came out. When the solution was applied to thoracic spiracles which had been rendered visible by cutting away portions of the fold in the body wall, it was noticed that the flaps continued their opening and closing movements for a while and then remained closed. Some of the liquid entered these spiracles before they remained closed. India ink was mixed with soap solution and a drop of the mixture kept over a single thoracic spiracle for several minutes. The insects so treated did not seem to be seriously injured and after they had remained alive a few hours were cut open and presence of the ink could be detected in some of the main tracheal branches leading from the treated spiracle. This was true both of the first and second pairs of spiracles.

Adult harlequin bugs were dipped in soap solution to which India ink had been added, and later cut open to see how far the solution had penetrated into the tracheae. Most of those that died quickly showed ink in the thoracic tracheae and sometimes in the first abdominal tracheae but the remaining abdominal trachaea did not contain any ink. In many cases the ink had penetrated deeply and had blackened most of the smaller branches. Bugs that lingered longer before dying showed less extensive penetration of the solution and in some cases not all of the thoracic spiracles had been entered. Bugs that showed some effect from the treatment but continued to live and were apparently on the road to

[2]H. Mammen. Über die Morphologie der Heteropteren—und Homopterenstigmen. Zoologischen Jahrbüchern, Vol. 34 (No. 1) pp. 121–178, pl. 7–9, 1912.

recovery sometimes showed ink in some of the main thoracic tracheal trunks but in most of such cases no ink could be discovered at all. Immature harlequin bugs that were dipped in the mixture of soap solution and ink, showed penetration of the liquid into both thoracic and abdominal spiracles. This took place in only a small fraction of the time required for the solution to enter the tracheae of the adults.

CONCLUSIONS. Soap solutions kill harlequin bugs by penetrating deeply into the tracheal system through part or all of the spiracles. A small amount of soap solution in one or two of the tracheal trunks probably does not cause death. On account of the spiracle closing devices on the adult harlequin bugs, soap solutions must remain on the body several minutes before a quantity sufficient to cause death enters the tracheae. A much shorter time is required to kill the nymphs on account of the rudimentary condition of the spiracle closing devices, but under conditions of very rapid evaporation many of them will not be killed.

From a practical standpoint it is evident that when dealing with soap solution one should not follow the usual practice of spraying during fair weather unless it is applied early in the morning when dew is on the plants. With soap solution much better results can be obtained by spraying during a light rain than on a clear dry day, especially if a wind is blowing. On calm, cloudy, humid days soap is a very effective insecticide in solutions of from one-half to two per cent, depending on the insect to be treated. Considering that soap is always on hand in the household there is no reason why it should not be more extensively used as an insecticide for home gardens.

PHYSICAL AND CHEMICAL PROPERTIES OF COMMERCIAL ARSENICAL INSECTICIDES

I. MANGANESE ARSENATE

By F. E. DEARBORN, *Insecticide Division, Bureau of Chemistry and Soils, Washington, D. C.*

ABSTRACT

The patented methods of making manganese arsenates for insecticidal use consist in treating a manganese compound, such as pyrolusite, with white arsenic (As_2O_3) in the presence of nitric acid as a catalyst. The manganous arsenate formed is partly converted to the trimanganoarsenate by treatment with manganese carbonate to lower the water soluble arsenic content. The brown color of the insecticide is produced by treating the mixed arsenates with lime, which decomposes some of the arsenates, with the formation of calcium arsenate and hydrated oxides of manganese. Burnt umber is also generally added to cheapen the product.

The chemical analysis of the commercial insecticide shows that the total arsenic content runs close to 40 per cent calculated as arsenic pentoxide As_2O_5; that the

water soluble arsenic content ranges from 0.7 arsenic pentoxide As_2O_5; and that the total manganese calculated as to 1.5 per cent calculated as manganous oxide (MnO) ranges from 31.6 to 40.7 per cent. The lime content, present mostly as calcium arsenate, ranges from 15.5 to 16.4 per cent calculated as calcium oxide (CaO).

The commercial manganese arsenate insecticide is a complex mixture of various arsenates of manganese, calcium arsenate, oxides of manganese and smaller quantities of aluminum, iron, silica, etc. The composition of different samples is not the same.

Manganese arsenates have only recently been used as insecticides, although they have been known for a long time. No record was found in the literature on the chemical analysis of manganese arsenate insecticides. The purpose of this paper, therefore, is to outline the methods of preparation and to give data on the chemical composition of commercial manganese arsenate insecticides now on the market.

HISTORICAL. The manufacture of manganese arsenate as an insecticide grew out of a demand for a product which would not produce undesirable coloration of the tobacco plant. When lead arsenate or any other white insecticide is used on the tobacco plant, it produces on the dried and cured leaves an appearance of mold, which reduces the selling price of the tobacco.

Prior to the development of manganese arsenate, efforts were made to color insecticides, such as lead arsenate. It was found, however, that organic dyes were not sufficiently permanent and that the use of colored pigments was not satisfactory because a comparatively large quantity of pigment is required to be mixed with the material, and the arsenic content of the product was rendered too low for effective use.

METHODS OF MANUFACTURE. The commercial methods for preparing manganese arsenates for insecticides are covered by patents[1,2], and consist mainly in treating compounds of manganese, such as the carbonate ($MnCO_3$) or pyrolusite (MnO_2) with commercial white arsenic (As_2O_3) or arsenic acid (H_3AsO_4) in combining proportion, in sufficient water to form a slurry which can be easily agitated. The mixture is kept nearly at 100° C. with continuous agitation for about 24 hours. By using a catalyst, such as nitric acid, the reaction time is reduced. The reaction that takes place is:

[1]U. S. Patent, 1,580,200, issued to Henry Howard, Apr. 13, 1926; appl. May 15, 1922.

[2]U. S. Patent 1,574,118, Feb. 23, 1926; appl. Sept. 29, 1924.

U. S. Patent 1,648,596, Nov. 8, 1927; appl. Sept. 29, 1924.

Canadian Patent 266,536, July 6, 1926;

This group of patents was issued to William K. Schweitzer.

U. S. Patent 1,591,795 issued to W. L. Tanner July 6, 1926; appl. July 30, 1923.

U. S. Patent 1,648,577, issued to Harry P. Corson, Nov. 8, 1927; appl. Sept. 29, '24.

(1) $2MnO_2+As_2O_3+H_2O=2MnHAsO_4$

The next step in the process is to reduce the water soluble arsenic present in the dimanganoarsenate ($MnHAsO_4$) by treating it with a small amount (5 to 10 per cent by weight of the white arsenic (As_2O_3) and pyrolosite (MnO_2) used) of a neutral or only slightly alkaline carbonate of a metal capable of forming an insoluble arsenate, such as manganese carbonate, calcium carbonate or magnesium carbonate. The carbonate is added to the reaction product obtained in (1) and the mixture agitated with heating to nearly 100° C. for 24 hours. The reaction that takes place when manganese carbonate is used, is:

(2) $2MnHAsO_4+MnCO_3=Mn_3(AsO_4)_2+CO_2+H_2O$

The carbonate reacts with a portion of the $MnHAsO_4$, forming the trimanganoarsenate, and the water soluble arsenic content is reduced, the extent depending upon the quantity of carbonate used and the time allowed for the reaction.

The color of both the dimanganoarsenate and the trimanganoarsenate ranges from white to pink. In order to impart a brown color to the insecticide, an alkali, such as lime, is added to the reaction product obtained in (2) above. The quantity of lime added and the length of treatment controls the color imparted to the finished product. When the mixture is kept at nearly the boiling point and thoroughly agitated, a maximum effect is obtained with any given amount of lime in about 24 hours. Lime amounting to 10 per cent of the original dry charge of white arsenic (As_2O_3) and pyrolosite (MnO_2) imparts a dark brown color to the finished insecticide. The lime decomposes some of the manganese arsenates, forming the corresponding calcium arsenate and manganese hydroxide, which is converted by oxidation with or without accompanying hydration to brown colored hydroxides or hydrated oxides. The final reaction product is filtered, washed, dried and ground to a fine powder. The arsenic content is generally reduced by the addition of burnt umber, which also helps to impart a brown color to the finished insecticide.

Analyses of Manganese Arsenate Insecticides. Two samples of commercial manganese arsenate insecticides were analyzed to determine their composition. Sample No. 1 was labeled "Manganar" and had the following statement on the label:

	Per cent
Total arsenic oxide	40.00
Arsenic as metallic arsenic	26.00
Water soluble arsenic as metallic arsenic not over	.50
Manganese arsenate	68.00
Inert ingredients	32.00

Sample No. 2 was received from the Bureau of Entomology and was labeled "Manganese Arsenate". The methods of analysis used in analyzing the samples were taken from the A. O. A. C. manual (Second edition, revised to July 1, 1924) and "Standard Methods of Chemical Analysis," by Scott (Second edition, revised Jan. 1917).

The cubic inches per pound was determined by passing the insecticide through a 30–mesh sieve, held about an inch above the receiving vessel of known value. The material was carefully leveled off and then weighed. When the weight of the material held by a definite volume is known the cubic inches occupied by a pound of the insecticide is readily calculated.

The p-H value was determined by means of the LaMotte Comparator using the La Motte color Standards. Ten grams of the arsenate were mixed with 500 cc of distilled water at room temperature (approximately 25°C) and allowed to stand for two hours with frequent shaking. Then samples were filtered off, and the p-H value determined. The p-H of the distilled water used was 6.6.

The suspensibility tests to determine the rate of settling of the suspended insecticide in water were carried out at approximately 25° C. A 1.2 g. sample of the insecticide was shaken with 500 cc of distilled water contained in a 500 cc graduated cylinder, and after the cylinder had stood for a definite time, the top half (250 cc) was siphoned off into a weighed beaker. The beaker was placed on the steam bath and the contents evaporated to dryness. The beaker and residue were dried and then weighed. The weight of the salts obtained by evaporation multiplied by 100 and divided by 0.6 gives the per cent of material held in suspension.

The chemical and physical data obtained from analysis are tabulated in Table 1.

There is no definite way of calculating the composition of the insecticide from the analysis as we are dealing with mixtures of several compounds and substances of unknown composition used as fillers, such as burnt umber, containing aluminum, calcium, iron, manganese, magnesium, silica, and other matter. The theoretical composition of the dimanganoarsenate ($MnHAsO_4$) is: Manganese, calculated as the manganous oxide (MnO), 36.5 per cent; arsenic, calculated as arsenic pentoxide (As_2O_5), 59.0 per cent. The composition of the trimanganoarsenate is: Manganese calculated as the Manganous oxide (MnO), 48.2 per cent; arsenic, calculated as arsenic pentoxide (As_2O_5), 51.9 per cent.

The insecticides probably consist of the arsenates of manganese, a small percentage of calcium arsenate, oxides of manganese, together

TABLE 1. ANALYSIS OF COMMERCIAL MANGANESE ARSENATE INSECTICIDES

	Sample No. 1 Per cent	Sample No. 2 Per cent
Moisture	1.7	1.2
Total arsenic pentoxide (As_2O_5)	39.9	40.6
Total arsenious oxide (As_2O_3)	None	None
Water-soluble arsenic pentoxide (As_2O_5)	1.5	0.7
Total water soluble salts at 25° C	4.4	7.0
Insoluble in hydrochloric acid (silicon dioxide, SiO_2)	0.8	1.4
Insoluble in nitric acid 1:1 (Oxides of Manganese)	5.5	7.3
Aluminum oxide (Al_2O_3); ferric oxide, (Fe_2O_3)	0.6	0.7
Total manganese as manganous oxide MnO	40.7	31.6
Total calcium oxide (CaO)	15.5	16.4
Total magnesium Oxide (MgO)	0.4	0.2
Cubic inches per pound	89.0	78.0
pH value of 2% solution	11.9	8.1
Suspensibility at 25° C. — 2 minutes	61.0	75.0
Suspensibility at 25° C. — 5 "	32.0	51.0
Suspensibility at 25° C. — 10 "	20.0	27.0
Suspensibility at 25° C. — 30 "	9.0	17.0
Suspensibility at 25° C. — 60 "	8.0	14.0

with uncombined material, and fillers, such as burnt umber. It is quite probable that sample No. 1 contains more of the trimanganoarsenate than sample No. 2 as the manganese content is considerably higher with approximately the same arsenic and calcium content. Sample No. 1 was slightly darker in color than sample No. 2.

The material insoluble in nitric acid (1:1) gives a rough estimation of the oxides of manganese present in the insecticide.

Samples of the insecticides were submitted to mocroscopical examination[3] to determine their uniformity and other characteristics. The microscopical test showed that this product was not uniformly one substance, but consisted of a mixture of rods and brown, amorphous material. The indices of refraction were not measurable with the facilities available, as they were greater than n = 1.69.

APPLICATION AGAINST INSECTS. A search of the literature revealed only a few references to experiments conducted with manganese arsenate against insect pests. The manufacturer places on the label of the container, together with the analysis, a statement that the product can by used for dusting tobacco, potato plants, cotton or truck crops.

D. E. Fink[4] made a study of the effect of the various arsenical compounds, including manganese arsenate, on the respiratory metabolism of the adult potato beetle, the larvae of the garden wire worm, and the

[3]The microscopical examination was carried out by George L. Keenan, of the Food, Drug and Insecticide Administration, Washington, D. C.

[4]Physiological Studies of the Effect of Arsenicals on the Respiratory Metabolism of Insects, J. Agr. Res. Vol. 33, No. 2, pp. 993–1007 (1926).

third stage larvae of the Japanese beetle. The evidence obtained points to the fact that arsenicals exert an inhibiting effect on the respiratory metabolism of the insects.

O. I. Snapp[5] made toxicity tests with a number of compounds against the plum curculio by spraying and dusting peach trees. Manganese arsenate was found to be less effective than the arsenates of lead, barium, calcium, zinc or magnesium.

The report[6] of the Committee to Formulate Plans for Investigating the Codling Moth states that three laboratory and seven field tests shows that manganese arsenate is about two-thirds as effective as lead arsenate. One case of severe injury and several cases of moderate injury to the trees were recorded.

D. J. Caffrey and L. L. Huber[7] experimented with manganese arsenate against the European corn borer and found it gave no effective protection for the growing corn.

C. H. Alden and M. S. Yeomans[8] carried out field experiments consisting of spraying and dusting apple orchards against the codling moth.

H. C. Young[9] used sulphur dust combinations against the apple scab. Sulphur-Manganar (Manganese arsenate) mixtures gave good control but caused slight injury.

R. L. Miller[10] states that manganese arsenate when used in the laboratory alone or with lime was not quite so effective in preventing the entrance of the newly hatched codling moth larvae into carefully sprayed apples as was lead arsenate. When mixed with lime-sulphur there was little difference in the effectiveness of the two materials. In the field tests manganese arsenate gave as good or better results when mixed with lime-sulphur as did lead arsenate. Lead arsenate was slightly better than manganese arsenate used alone. The residue of manganese arsenate was more easily removed from the apples than was that of lead arsenate.

[5]A Preliminary Report of Toxic Value of Fluosilicates and Arsenicals as tested on Plum Curculio, J. Econ. Ent. *21*, No. 1, pp. 175–178 (1928).

[6]Report of Committee to Formulate Plans for Investigations of the Codling Moth from Biologic and Control Standpoints. J. Econ. Ent. *21*, No. 1, pp. 36 (1928).

[7]Fundamental Phases of European Corn Borer Research. J. Econ. Ent. *21*. No. 1, pp. 104 (1928).

[8]Codling Moth Control in Georgia Apple Orchards. J. Econ. Ent. 21, No. 2, pp. 319 (1928).

[9]Ohio Agricultural Experiment Station Bimonthly Bulletin *14* No. 2, Mar. Apr. 1929.

[10]Manganese Arsenate as a Control for the Codling Moth, J. Econ. Ent. *22*, No. 2, pp. 340 (1929).

PRELIMINARY REPORT ON PARADICHLOROBENZENE SOLUTIONS FOR THE CONTROL OF THE LESSER PEACH BORER, *AEGERIA PICTIPES*, G. & R.

By OLIVER I. SNAPP, *Entomologist*, and H. S. SWINGLE, *Assistant Entomologist*, *Division of Deciduous Fruit Insect Investigations, U. S. Bureau of Entomology*

ABSTRACT

Paradichlorobenzene solutions appear very promising for the control of the larvae of the lesser peach borer in peach trees. The best of these solutions tried was that in which crude cottonseed oil was used as the solvent for the paradichlorobenzene.

The lesser peach borer has been recognized as a pest of considerable importance upon peach since 1896. While apparently preferring peach, it also attacks and causes more or less injury (2)[1] to plum, cherry, Juneberry, beach plum, and chestnut.

Injury is due to the destruction of the cambium and inner bark layers by the feeding of the larvae. In severe cases limbs may be entirely girdled and killed, and in practically all cases the trees are very greatly weakened As these larvae apparently prefer to enter only thru wounds in the outer bark, or at old crotches or sun scalded areas, severe injury is largely confined to older trees.

The only control previously recommended as effective was hand worming. Owing to the unsatisfactory nature of this method of control, and to the fact that trees are very seldom killed by the attacks of this insect, no control measures whatever have been used in Georgia peach orchards, with a few exceptions. As a result heavy infestations can usually be found, especially in the older orchards.

The success of Hamilton (3) with a solution of paradichlorobenzene in soluble pine-tar creosote for the control of various boring insects, and of Gilbertson (1, 4, 5) with a solution of this same insecticide in melted paraffin for the control of the lesser peach borer in plum trees, stimulated interest in this method of control for the latter insect in peach trees. The work here reported was carried on at the U. S. Peach Insect Laboratory, Fort Valley, Georgia, during 1928 and 1929. While of a preliminary nature, the results seemed of sufficient importance to be reported at this time.

EXPERIMENTAL. A paraffin solution of paradichlorobenzene, as recommended by Gilbertson (4), was applied to the infested portion of peach trees on November 7, 1928. This contained one pound paradichlorobenzene dissolved in four pounds of paraffin. As it was felt that

[1]Numbers in parenthesis refer to "Literature Cited."

the paraffin might prove too brittle, grafting wax was substituted for the paraffin in another series of tests. These solutions were kept warm and were applied to the infested portions of the trees with a paint brush, no attempt being made to remove the gum or frass or to otherwise expose the tunnels of the larvae. The results of these tests are given in Table 1.

TABLE 1. RESULTS OF TESTS WITH PARADICHLOROBENZENE SOLUTIONS APPLIED NOV. 7, 1928, FOR THE CONTROL OF THE LESSER PEACH BORER

Material used	Total Larvae examined and the per cent found dead at each examination after exposure of— 1 week		2 weeks		3 weeks		6 weeks	
	Total	Per cent dead	Total	Per cent dead	Total	Per cent dead	Total	Per cent dead
Paraffin and paradichlorobenzene	22	54.5	46	65.2	33	40.0	14	85.7
Paraffin alone	11	9.1	25	0.0	15	0.0	21	0.0
Grafting wax and paradichlorobenzene	18	44.4	24	29.2	13	38.5	—	—
Grafting wax alone	13	0.0	20	0.0	10	10.0	—	—

Altho these results appeared promising, it was evident that this method of control would not prove very popular unless some material, not requiring the use of heat to render it fluid, were substituted for the above solvents. Therefore, solutions of paradichlorobenzene dissolved in soluble pine-tar creosote and in cottonseed oil were tried in comparison with the paraffin solution. One pound of paradichlorobenzene was dissolved in one quart of soluble pine-tar creosote, and then diluted with one quart of water as recommended by Hamilton (3); and one pound was also dissolved in two quarts of crude cottonseed oil. These materials were applied with a brush on April 2, 1929, and the results of these tests are given in Table 2.

TABLE 2. RESULTS OF TESTS WITH PARADICHLOROBENZENE SOLUTIONS APPLIED APRIL 2, 1929, FOR THE CONTROL OF THE LESSER PEACH BORER

Material Used	Total Larvae examined and the per cent found dead at each examination after exposure of 1 week		2 weeks	
	Total	Per cent dead	Total	Per cent dead
Paraffin and parachlorobenzene	9	77.7	33	90.0
Cottonseed oil and paradichlorobenzene	10	90.0	47	97.9
Cottonseed oil alone	—	—	11	45.4
Soluble pine-tar creosote and paradichlorobenzene	11	72.7	14	85.7
Soluble pine-tar creosote alone	9	11.1	20	20.0
Check—untreated	—	—	15	6.6

DISCUSSION OF RESULTS. The spring applications (Table 2) gave uniformly better results owing to the more rapid volatilization of the para-

dichlorobenzene, caused by the higher temperatures prevailing during the two-week period of these tests. The average temperature thruout this period was 69.1°F. and the maximum for every day was above 70°F. The average temperature for the corresponding period of the fall tests (Table 1) was 57.5°F. and the maximum daily temperatures reached 70°F. or above on only seven of the first fourteen days during that period. Apparently fall applications must be made earlier than November for most effective results.

Grafting wax proved no more effective than paraffin as a solvent and was much more disagreeable to use. The paradichlorobenzene dissolved in paraffin proved effective, but did not give quite as good control as when crude cottonseed oil was used as the solvent. This was probably due to the better spreading and penetrating power of the latter.

Soluble pine-tar creosote as a solvent gave as good results as the paraffin.

It seems quite probable that a solution of paradichlorobenzene in any solvent having good penetrative power would prove effective.

Cottonseed oil and the creosote both showed some insecticidal action when used alone, apparently acting as contact insecticides.

The somewhat erratic results noted in Table 1 were apparently due to the excessive quantities of gum produced by some trees closing the larval burrows and preventing the penetration of the insecticide. Better results would be secured if this were removed before the application.

No injury to the trees could be detected.

Literature Cited

1. Gilbertson, G. I. 1929. Controlling Plum Pest with P.D.B. Am. Fruit Growers Magazine, May, 1929, page 10.
2. Girault, A. A. 1907. The Lesser Peach Borer. U. S. Bureau of Entomology Bul. 68, Part 4.
3. Hamilton, C. C. 1926. Some Tests of Para-dichlorobenzene Dissolved in Soluble Pine Tar Creosote in the Control of Boring Insects in Living Plants. Report Dept. Entomol. N. J. Agr. Exp. Sta. for Year Ending June 30, 1926, pages 196–197.
4. South Dakota Agricultural Experiment Station. 1927. The Plum Tree Borer. Annual Report of the Director for the Year Ending June 30, 1927, pages 15–18.
5. ——— 1928. The Plum Tree Borer. Annual Report of the Director for the Year Ending June 30, 1928, pages 17–18.

COMMON NAMES OF INSECTS APPROVED FOR GENERAL USE BY AMERICAN ECONOMIC ENTOMOLOGISTS

FIFTH SUPPLEMENT TO LIST APPEARING IN VOLUME 18, PAGES 521–545, 1925

A list of 36 common names was submitted to the active members of the Association for approval with the understanding that a name be considered adopted when less than 20 per cent of the votes cast was in opposition. Of this list the following 23 names received the necessary votes for adoption:

INSECTS LISTED BY SCIENTIFIC NAMES

Anthonomus grandis thurberiae Pierce	Thurberia weevil
Anticarsia gemmatilis Hbn	Velvetbean caterpillar
Argyresthia conjugella Zell	Apple fruit moth
Barathra configurata Walk	Bertha armyworm
Chalcodermus aeneus Boh	Cowpea curculio
Cryptococcus fagi Bar	Beech scale
Ellopia fiscellaria Guen	Hemlock spanworm
Eriophyes gossypii Banks	Cotton blister mite
Hemerophila pariana Clerck	Apple and thorn skeletonizer
Hypoderma bovis DeG	Northern cattle grub
Hypoderma lineatum DeVill	Common cattle grub
Laspeyresia molesta Busck	Oriental fruit moth
Myelois venipars Dyar	Navel orange worm
Nephopteryx rubrizonella Rag	Pear fruit borer
Parlatoria blanchardi Targ	Parlatoria date scale
Pegomyia hyoscyami Panz	Spinach leaf miner
Phoenicococcus marlatti Ckll	Red date scale
Phytonomus nigrirostris Fab	Lesser clover leaf weevil
Pogonomyrmex barbatus Mayr	Red harvester ant
Pseudococcus maritimus Ehrh	Grape mealybug
Pulvinaria amygdali Ckll	Cottony peach scale
Rhagoletis juglandis Cress	Walnut husk fly
Rhizoglyphus hyacinthi Boisd	Bulb mite

INSECTS LISTED BY COMMON NAMES

Apple and thorn skeletonizer	Hemerophila pariana Clerck
Apple fruit moth	Argyresthia conjugella Zell.
Beech scale	Cryptococcus fagi Bar.
Bertha armyworm	Barathra configurata Walk.
Bulb mite	Rhizoglyphus hyacinthi Boisd.
Common cattle grub	Hypoderma lineatum DeVile.
Cotton blister mite	Eriophyes gossypii Banks
Cottony peach scale	Pulvinaria amygdali Ckll.
Cowpea curculio	Chalcodermus aeneus Boh.
Grape mealybug	Pseudococcus maritimus Ehrh.
Hemlock spanworm	Ellopia fiscellaria Guen.
Lesser clover leaf weevil	Phytonomus nigrirostris Fab.
Navel orange worm	Myelois venipars Dyar
Northern cattle grub	Hypoderma bovis DeG.
Oriental fruit moth	Laspeyresia molesta Busck
Parlatoria date scale	Parlatoria blanchardi Targ.
Pear fruit borer	Nephopteryx rubrizonella Rag.
Red date scale	Phoenicococcus marlatti Ckll.
Red harvester ant	Pogonomyrmex barbatus Mayr
Spinach leaf miner	Pegomyia hyoscyami Panz.
Thurberia weevil	Anthonomus grandis thurberiae Pierce
Velvetbean caterpillar	Anticarsia gemmatilis Hbn.
Walnut husk fly	Rhagoletis juglandis Cress.

IMPORTANT NOTICE

43rd Annual Meeting of the American Association of Economic Entomology, Cleveland, Ohio, December 29, 1930 to January 2, 1931

As a result of correspondence with the Sections of this Association, the Committee on Program and the Entomological Society of America, a schedule has been arranged for the sessions at the Cleveland meeting. This information is made available at this time for the information of the members and in the hope that it will stimulate attendance at the meeting.

Monday, December 29, 1930—The section of Apiculture will hold sessions in the morning and afternoon.

Tuesday, December 30, 1930—The section of Plant Quarantine and Inspection will hold sessions in the morning and afternoon. The Entomological Society of America will hold sessions in the morning and afternoon and the public address before that Society will be held in the evening.

Wednesday, December 31, 1930—The general session of this Association will be held in the morning and afternoon and the Entomological Society of America will also hold sessions during those periods. The Entomologists dinner will be held in the evening.

Thursday, January 1, 1931—General sessions of the Association will be held in the morning and afternoon and the Extension Entomologists will meet in the evening.

Friday, January 2, 1931—General sessions of the Association will be held in the morning and afternoon, the final business being conducted at the closing session.

A. F. Burgess, *Secretary*

Scientific Notes

A New Host Record for the White Pine Weevil. To the list of native and exotic conifers known to be attacked by the white pine weevil, *Pissodes strobi* (Peck), *Pinus montana*, the ornamental Swiss mountain pine, may be added. A variety of this pine, *Pinus montana mughus*, has already been reported in the literature as a host plant (MacAloney).

The Mount Desert Nurseries, Bar Harbor, Me., brought to the attention of the writer the infestation of a number of their mountain pines. The leaders, which presented the usual weeviled appearance, when dissected, offered definite evidence that *Pissodes strobi* was the insect responsible for the injury.

In the material examined, the fly, *Lonchaea corticis* Taylor, which is facultatively parasitic upon this weevil, was noted (a new record for the island).

Raymond L. Taylor, *Maine Forest Service Entomological Laboratory, Bar Harbor*

An Unrecorded Food-Habit of the Large Tobacco Suck-Fly in Porto Rico. The large tobacco suck-fly, *Dicyphus luridus* Gib., has been known for some time as a relatively unimportant pest of tobacco in Porto Rico. Its injury has always been described, however, as damage to the leaves from which it sucks the juices, thus tending somewhat to weaken the plant.

Early in March 1930 Mr. J. A. B. Nolla of the Division of Botany of the Insular Experiment Station reported serious injury to the flower-buds of tobacco in a large breeding experiment which he was conducting near Caguas, P. R. Injury to the

flower-buds of tobacco would, of course, tend to reduce seed production but in this case it was particularly desirable to keep these parts intact for the purpose of obtaining as much seed as possible from presumably desirable new strains.

On March 14 the writer accompanied Mr. Nolla to Caguas to observe the damage. The insects were found to be exceedingly abundant on the plants selected for breeding purposes and which were situated in the center of a large field of tobacco. Many of the flower-heads almost literally swarmed with suck-flies and when disturbed the adults flew out in considerable numbers. The extraction of the juices was causing the flower-buds to fall, thus reducing the number of potential seed-capsules in most of the plants to not more than 10 per cent. After removing all opened flowers a paper bag had been fastened with a paper-clip over each flower-head to prevent cross-pollination. These bags had, however, failed to keep out sufficient of the suck flies to prevent considerable loss.

M. D. LEONARD, *Chief Div. of Entomology Insular Experiment Station at Rio Piedras, P. R.*

Further Notes on the Hawthorn Carposina Which Attacks Apples in Missouri. At the Des Moines meetings[1] the writer gave a short paper on the new mining caterpillar of apple which was identified as a species of Carposina. Breeding material kept in the laboratory during the winter is just beginning to emerge and specimens of the moths have been sent to the Bureau of Entomology for identification. The material kept under outdoor conditions is still in the larval stage and it is believed that the moths will not emerge until fall when apples and red haws are attacked by the larvae.

Before pupating the larva opens its spherical cocoon, drags it to the surface of the ground, and enlarges it so that it is about ten millimeters long, or twice its original diameter. Then it pupates being at first whitish but, when the moth is ready to emerge, it takes on a darker color. The pupa is about 6 to 8 millimeters long. The adult is a beautiful gray moth with small dark patches of elevated scales on the front wing. It has recently been identified by Mr. Heinrich, as *Carposina fernaldana*.

LEONARD HASEMAN, *University of Missouri*

Terpineol, a Solvent for Removing a Commercial Tree-Banding Material from Insects. In its study of the dispersion of certain insect pests, the Division of Cotton Insects of the U. S. Bureau of Entomology is using screens coated with a commercial tree-banding material to capture insects in flight. Many of these insects that were received by the Taxonomic Unit of the U. S. Bureau of Entomology were so heavily coated with this adhesive that they could not be studied. At the request of Dr. Harold Morrison, the writer endeavored to dissolve the adhesive from the insects. Of numerous solvents tested, only one, terpineol, was entirely satisfactory.

Entomologists wishing to use this adhesive for collecting insects may remove it from their specimens as follows: Coated insects are immersed in terpineol and heated on a boiling water bath for about five minutes, or longer, if necessary. The cleaned insects can then be transferred directly to alcohol or can be pinned. Coated specimens that have been preserved in alcohol can be treated equally well with terpineol. Insects as delicate as aphids can be cleaned without injury by the foregoing methods.

F. L. CAMPBELL, *U. S. Bureau of Entomology*

[1]Journal of Economic Entomology, Vol. XXIII, No. 1, Page 91.

***Dicyphus minimus* Uhler, a Pest on Tomatoes (Hemiptera, Miridae).**[1] During the past summer, 1929, complaints of an unusual type of insect attack upon tomatoes were received by this department. These complaints came from several different localities in Texas and the damage reported as being severe. Upon receipt of specimens the pest was found to be *Dicyphus minimus* Uhler. Some time later this species was found attacking tomatoes on the horticultural farm at College Station, Texas. Observations of the damage being done here convinced the writer of the seriousness of this pest and also confirmed the reports from other localities.

The pest was first reported early in July and occurred in enormous numbers throughout the summer and fall, disappearing only with the coming of cold weather. The nymphs were found principally on the underside of the leaves while the adults were to be found on any part of the plant. Leaves, stems, blossoms, and small fruits were attacked, all showing characteristic lesions and scars that are produced by the feeding punctures made by members of this family. The leaves began to show numerous white spots and later to turn yellow and curl around the edges. The young fruits were punctured either before or at blooming time, which caused them to drop off. One report from San Marcos, Texas, stated that several acres of tomatoes produced only a very small percentage of a normal crop because of the damage done by this insect.

Dicyphus minimus Uhler was first reported by A. L. Quaintance (Fla. Agr. Exp. Sta. Bul. 48, 1898) as being the most serious pest on tobacco in Florida. In this bulletin is given the complete life history and control of the species with illustrations of the nymph and adult. He states that the pest has been observed during October, November and early December on tomato vines and egg plants, but were nothing like so numerous as on tobacco.

Dr. H. H. Knight (Can. Ent. LIX. 36, 1927) states that this species breeds on *Nicotiana trigonophylla* and the writer, during the summer 1929, collected specimens in Mississippi that were breeding on *Solanum nigrum*. It probably breeds also on other wild solanaceous plants.

H. G. JOHNSON

Relative Covering Power of a Miscible Oil and Lubricating Oil Emulsions. Since the publication of the first report on this subject in the Journal of Economic Entomology, Vol. 22, No. 5, October, 1929, an interested manufacturer has raised the question of the size of the aperture in the nozzle discs used in the tests. We have therefore repeated the tests, using nozzles and discs supplied by the manufacturer in question, and nozzles and discs of the kind that are generally used in the Georgia peach belt.

The commercial miscible oil used for the first tests was again selected for comparison with Government-formula soap lubricating-oil emulsion and a commercially manufactured soap lubricating-oil emulsion. The second tests included the number of trees covered by 200 gallons of each insecticide and the time required to spray out 200 gallons of each into barrels. The most uniform trees in this section were selected for the tests, and all sprays were applied with a power outfit maintaining a constant pressure of 225 pounds. Two of the best spray men in this locality did the spraying under the supervision of the writers.

[1]Contribution No. 21 from Department of Entomology, A. and M. College of Texas, College Station, Texas.

The results of these tests were as follows

Test No.	Insecticide used[1]	Nozzles used on each of two leads of hose	Number of trees covered by 200 gallons	Time required to spray 200 gallons on trees	Time required to spray 200 gallons into barrels
1	Commercial miscible oil	Cluster of 4 supplied by manufacturer			51 minutes
	Government-formula soap-oil emulsion	Cluster of 4 supplied by manufacturer			48 minutes
	Commercial soap-oil emulsion	Cluster of 4 supplied by manufacturer			50 minutes
2	Commercial miscible oil	Twin, purchased locally (small aperture in discs)	246	1 hr. 34 min.	
	Government-formula soap-oil emulsion	Twin, purchased locally (small aperture in discs)	290	1 hr. 32 min.	
	Commercial soap-oil emulsion	Twin, purchased locally (small aperture in discs)	244	1 hr. 38 min.	
3	Commercial miscible oil	Clusters of 4 supplied by manufacturer	192	1 hr. 4 min.	
	Government-formula soap-oil emulsion	Clusters of 4 supplied by manufacturer	178	1 hr. 0 min.	

OLIVER I. SNAPP and J. R. THOMSON,
U. S. Peach Insect Laboratory, Fort Valley, Georgia

Peruvian Potato Pests. The original habitat of the so-called Irish potato is not Ireland, as its name might appear to indicate, but the foothills and valleys of the Andean mountains in South America, much of which region is included in the non-tropical portions of Peru. Little is known of the insect pests attacking the potato in Peru, the most extensive article concerning them consisting of descriptions of beetles taken from tubers being imported into the United States and intercepted by agents of the Federal Horticultural Board. (Pierce, W. Dwight, "New Potato Weevils from Andean South America." Jour. Agr. Research, Vol. 1, No. 4, pp. 347–352, pl. 3, Jan. 10, 1914. Washington, D. C.) These beetles and their larvae are by no

[1]The diluted miscible-oil spray contained 5.5 per cent of oil by volume, whereas the oil emulsions contained 3 per cent of oil by volume. These are the strengths recommended in this locality.

means the most destructive pests of the tubers, which are more often attacked by pale greyish-yellow cut-worms of which the reared adults have recently been identified by Mr. Wm. Schaus as *Lycophotia interrupta* Maassen. These caterpillars feed on the tubers in the ground, hollowing out great cavities and entirely unfitting those attacked from being consumed by man. They are possibly more of a benefit than otherwise, however, in cleaning up all the small potatoes and culls left in the fields when the crop is dug, so that there are seldom any volunteer potato plants in a following crop. The extent of the distribution of this cutworm is unknown, the present record being from near Lima.

The foliage of the potato plants around Lima appeared to be almost entirely devoid of insects, the rather rare large green leafhoppers sometimes noted on it having been identified only to genus, *Cicadella* sp. In the mountains, however, at least two species of leaf-feeding beetles have been observed in enormous abundance on potato and causing very serious damage. The genus of the "old-fashioned potato beetle" is represented by *Epicauta latitarsis* Haag, as determined by Mr. G. E. Bryant of the British Museum, a rather small, blue-black species found in great abundance at Tarma in February 1929 by Dr. E. V. Abbott. Even more interesting was a small Dasytid beetle, dull chestnut brown and irridescent greenish blue-black in color, *Astylus sublunulatus* Pic, which was very abundant feeding on potato foliage in fields around Huancayo. Both of these beetles are well known to the native potato growers, who had both Spanish and Quechwa (Indian) names for them, but the idea of destroying them or doing anything to protect their crops from them is too radical and revolutionary to be considered.

GEORGE N. WOLCOTT, *Barneveld, N. Y.*

Injury to Celery in the Sanford, Florida, District by the Larvae of the Noctuid Moth *Perigia sutor* Guen. The unprecedented prevalence of the noctuid, *Perigea sutor* Guenee, in the larval stage on celery in the Sanford, Florida, district during the earlier part of the growing season 1929–30 has been marked by a certain amount of damage to the crop. Since the insect occurred in only a few localized areas in the district during the 1928–29 season it did not then attract the attention of the growers but its far greater abundance and wider distribution during the current season caused some apprehension among them.

Moths reared from larvae taken on celery in the field in December were determined as this species by Dr. Wm. Schaus of the taxonomic unit of the U. S. Bureau of Entomology.

Our field observations indicate that the larvae of *P. sutor* are most abundant in celery of medium or good size, in December and January; after this time they did not occur in sufficient numbers to attract attention. Apparently they are more or less nocturnal in their feeding habits, for during the day they are frequently found lying in the crown of the plant where little feeding injury is to be noted. Often they lie in the inner concave side of the base of a petiole where the most conspicuous damage is done. Here large irregular cavities or elongate grooves are cut, sometimes almost through the petiole. The tissue immediately adjacent to the feeding area becomes discolored, and not infrequently decay sets in and renders this part of the plant unfit for packing, so heavier stripping becomes necessary at the time of harvest.

By way of acquiring roughly some notion of the injurious habits of these larvae, 60 celery plants were selected at random in one of the most heavily infested fields

about Sanford in December, 1929. Of these plants, 17 were badly injured, 31 were slightly injured, and 12 showed no injury. It seems likely that most of the damage observed was done by the larvae of *Perigea*, since they comprised 63 per cent of all the larvae present in the field.

Again, in an attempt to formulate some opinion regarding the relative abundance and seasonal occurrence of these larvae, surveys taken in 1929 on a field of nearly mature celery showed the presence of injurious larvae in the following proportions:

	December Per cent	January Per cent
P. sutor	17	63
"Cutworms"	23	14
"Loopers"	11	14
Semitropical army worm (*Prodenia eridania* Cram.)	49	9

It seems, therefore, that while the larva of this noctuid has not before been recorded as being of economic importance in the production of celery, its apparent increase in abundance in the Sanford district in the past few seasons, together with the nature of the damage that it inflicts, causes it to be reckoned as a potential pest and worthy of consideration as such.

DAYTON STONER and C. B. WISECUP, *U. S. Bureau of Entomology*

Longevity of the Mexican Bean Beetle in the Southwest. On July 11, 1924, at Estancia, N. Mex. overwintered Mexican bean beetles were collected, marked and liberated for the purpose of obtaining records of dispersal. At that time the majority of the beetles were just issuing from hibernation and had not yet deposited eggs. One of the marked beetles was recaptured in the same field on September 12, 1924. This beetle had undoubtedly matured by September 1, 1923, since the last beans in the locality had been harvested by September 16, 1923.

On September 12, 1924, this beetle was transferred to a wide-mouthed bottle containing moist sand and placed in the laboratory. Moisture was supplied at intervals by adding water to the sand. The female was observed daily and found dead on January 18, 1925. This female beetle lived approximately 505 days.

Beetles were collected in the Rio Grande Valley near Albuquerque, New Mexico, on September 15 or 16, 1927, transported to the laboratory, and retained in a concentration cage and fed daily until October 6. On this date the insects were placed in a hibernation cage at 7,050 feet elevation. On May 10, 1928, a roof was placed over the cage to exclude natural precipitation during the emerging season. One of the beetles had not emerged from hibernation by August 4, when the last seasonal examination was made. On October 4, a female beetle (No. 2) was noted in the cage crawling over the hibernation material. It was removed from the cage and placed on beans in the insectary. On October 15, it was transferred from the insectary to the cellar for hibernation, and died sometime during the winter. This beetle lived a minimum of 396 days and was without food for 363 days.

On September 11, 1928, beetles were collected in the Rio Grande Valley. They were handled similarly to beetle No. 2 during the pre-hibernation period. On September 28 they were transferred to a hibernation cage at 8,400 feet elevation and during the summer of 1929 active beetles were removed at intervals until emergence had apparently ceased. The last examination was made on August 18. However, on September 24, 1929, a female beetle was noted crawling on the wire screen in the cage.

The beetle was removed from the cage and placed in the cellar to hibernate. It was observed daily and died on October 21, 1929. This female lived a minimum of 405 days and was without food for 392 days.

In 1924 the length of life of 23 overwintered beetles varied from a mimimum of 287 to a maximum of 410 days with an average of 357 days. One male and 2 females were placed in hibernation on October 15 but did not survive the second winter.

In 1925 the length of life of 33 overwintered beetles varied from the minimum of 261 days to the maximum of 418 days; with an average of 375.5 days. One of them, a male beetle, was placed in hibernation on November 4 and died during the second winter.

In 1926 the length of life of 46 overwintered beetles varied from a minimum of 267 days to a maximum of 413 days; with an average of 357 days. Two males and one female were placed in hibernation on October 25, but none survived the second winter.

In 1927 the length of life of 46 overwintered beetles varied from a minimum of 271 to a maximum of 388 days; with 361 days as the average. Eleven males and 6 females were placed in hibernation on October 12 for the second time but succumbed before spring.

In 1928 the length of life of 47 overwintered beetles varied from a minimum of 271 to a maximum of 440 days; with an average of 373 days. Of the 47 beetles twelve males and 5 females were placed in hibernation on October 16, but again all of them died during the second winter.

In 1929 the length of life of 44 overwintered beetles varied from a minimum of 301 to a maximum of 454 days, with an average of 371 days. Five males and 2 females were placed in hibernation on October 16 for their second winter. The last beetle lived 491 days and died on December 16.

J. R. DOUGLASS, *Associate Entomologist, U. S. Bureau of Entomology*

ROCKY MOUNTAIN CONFERENCE OF ENTOMOLOGISTS

The seventh annual meeting of the Rocky Mountain Conference of Entomologists will be held in Pingree Park, Colorado, August 18 to 23. Anyone interested in attending this meeting can get further details by writing the Secretary. The meeting is so arranged that members of the family can join in the gathering. Meals and bedding are furnished at the Colorado Agricultural College Forestry Lodge, at cost. The sessions for papers are usually quite informal with ample time for discussion. Time is provided for collecting and a certain amount of recreation.

GEORGE M. LIST, *Secretary.*

JOURNAL OF ECONOMIC ENTOMOLOGY

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JUNE, 1930

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication at $2.50 per page for all matter in excess of six printed pages, a part page counting as a full page, this limit not including acceptable illustrations. Photo-engravings may be obtained by authors at cost.

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ANNUAL SCIENTIFIC MEETINGS: 1930–31, Cleveland; 1931–32, probably New Orleans; 1932–33, Chicago; 1933–34, undecided; 1934–35, probably Rochester.

It is a source of gratification to note the recent deposit in the United States National Museum of a valuable collection of Philippine Island insects. Our National Museum should be the repository of all noteworthy collections. The further development of this policy may well be a matter of concern to economic entomologists, since in the final analysis, accurate records are impossible without authoritative determinations, and these can be made only by an adequate corps of specialists with abundant material at hand from all parts of the world. The interests of economic entomology can not be limited by frontiers or even by oceans—they are world wide in scope.

An experiment covering tracts totaling 1000 acres is out of the ordinary. It has been made possible by a Congressional appropriation of $100,000 for work with the oriental fruit moth. The bill provided for large scale experiments with bait traps on two 500 acre tracts located in different fruit sections in order to obtain data as to the efficacy of the method. The localities selected are Cornelia, Ga., and Vincennes, Ind. A test over such an area should give information of great practical value and in connection with this, much other data will be obtained, some of which should be of value not only in controlling the oriental fruit moth but of service in checking other pests.

Reviews

The Use of the Microscope, A Handbook for Routine and Research Work by JOHN BELLING, pages I–XI, 1–315. McGraw-Hill Book Company, New York, 1930.

This is a well written, comprehensive account of the microscope and its possibilities, prepared by one qualified by years of experience in microscopic work. The volume is concerned primarily with descriptive accounts of various types of microscopes, the possibilities with the use of various accessories, methods of testing and drawing and is concluded with a comprehensive bibliography for those who wish to go beyond the limits of its pages. There are several excellent features in this work, namely, the practical points summarizing the contents of the more important chapters, the list of one hundred microscopical objects with brief technical directions for manipulation and the series of 200 questions which can be used by reader or student to test his understanding of the information presented in this volume. The book should be on the shelves of all engaged to any extent in microscopic work.

E. P. F.

A General Textbook of Entomology, Including the Anatomy, Physiology, Development and Classification of Insects by A. D. IMMS, pages I–XII, 1–703, 607 figures. E. P. Dutton & Company, Inc., New York, 1929.

This revised edition of a really comprehensive reference textbook dealing with the anatomy, physiology, development and classification of insects is too well known in its first edition to require an extended review at this time. The volume is a well arranged, well balanced discussion of the phases of entomology ordinarily covered by several distinct and independent works. The revision, mostly as addenda and the insertion of supplementary references, brings the book up to date and leaves little to be desired by those wishing general information in relation to many phases of entomology.

The aim of the author has been to provide a textbook of collegiate and university grade for the use of both teacher and advanced student. He has succeeded admirably in the presentation of subject matter and the numerous well selected references for each of the important divisions make this volume an excellent introduction to the extensive and varied sources of original information. The discussions of anatomy and physiology are as indispensable to the entomologist or student resident in the tropics as to those working under the climatic conditions of the temperate zone. The marked attention given to the early stages is a most commendable feature. The world wide scope of the work makes it almost indispensable to those interested in the broader lines in any part of the world.

E. P. F.

Current News Notes

Geo. W. Still, Assistant Entomologist, Bureau of Entomology, was reinstated on April 2 for duty at Sandusky, Ohio.

T. E. Bronson, formerly Agent, Bureau of Entomology, at the Madison, Wis., field laboratory, has received a probational appointment as Junior Entomologist.

Mr. N. A. Patterson, Entomological Branch, who has been taking postgraduate studies at Macdonald College, Quebec, returned to the laboratory on Feb. 24.

Dr. M. W. Blackman, specialist on bark beetles, left Washington on May 1 for a summer's field work on forest insects at Prescott, Ariz.

On March 31, A. O. Larson, Bureau of Entomology, who had for some time been in Washington, preparing manuscripts, left for his office at Modesto, Calif.

In March, Emory D. Burgess was appointed Junior Entomologist for duty at Arlington, Mass., and Antonio A. Celaya, Junior Laborer, for duty at Tempe, Ariz.

Joseph R. Gross has been given a temporary appointment as Field Assistant, Bureau of Entomology, for duty at Babylon, N. Y., in connection with the investigations of bulb insects.

Miss Irene Bartlett, a graduate in entomology of the Massachusetts Agricultural College, has been appointed Junior Entomologist, to assist in general identification work of the Taxonomic Division.

K. A. Salman, formerly with the Massachusetts Agricultural College, has been appointed agent at the Bureau of Entomology, Forest Insects field station at Palo Alto, Calif., and reported for duty April 14.

Rodney Cecil, Bureau of Entomology, returned on April 28 to the field laboratory at Geneva, N. Y., where he will resume his studies on bean insects. He spent last winter at the field laboratory at Columbus, Ohio.

J. A. Stear, Entomologist at the Chambersburg laboratory of the Pennsylvania Dept. of Agriculture, resigned March 1st to begin work with the Koppers Coke Co. of Pittsburgh. He will be located at the Koppers Experimental Farm at Ligonier, Pa.

Field assistants, Bureau of Entomology, who have recently been appointed are W. I. Duplessis and G. H. York, for service at Alhambra, Calif., R. D. Church, at Walla Walla, Wash., R. J. Severance at Toppenish, Wash., and H. L. Dees, at Grand Bay, Ala.

C. F. Stahl, Bureau of Entomology, Chadbourn, N. C., visited Hammond, Baton Rouge, and other points in the strawberry-growing region of Louisiana, April 17 to 19, to ascertain whether the strawberry root apid was a serious hindrance to the production of strawberries there.

Dwight F. Barnes, Bureau of Entomology, formerly on the staff of the Gipsy-Moth Laboratory, Division of Forest Insects, was transferred April 1, 1930, to the laboratory for the study of dried-fruit insects. Mr. Barnes left Washington for Fresno, Calif., on April 19th.

K. L. Cockerham and O. T. Deen, of Biloxi, Miss., spent the interval from March 18 to March 25 in northwestern Florida, scouting for the wireworm, *Heteroderes laurentii*, in the course of which they visited Escambia, Santa Rosa, Okaloosa, Walton, Holmes, Jackson and Bay Counties.

Dr. Walter Carter, Bureau of Entomology, who has been in charge of the investigations of the sugar-beet leafhopper, with headquarters at Twin Falls, Idaho, since its inauguration in 1925, resigned March 21, to accept a position as entomologist with the Pineapple Growers' Experiment Station, University of Hawaii, Honolulu.

A branch office of the Yakima, Washington, laboratory of the Bureau of Entomology has been established at Wenatchee, Washington, for the study of the relation of woolly aphis and other insects to perennial canker. Mr. M. A. Yothers has been transferred from the Yakima to the Wenatchee laboratory to carry on these investigations in cooperation with the plant pathologists of the Bureau of Plant Industry.

Dr. C. I. Bliss, Bureau of Entomology, was transferred on March 5 to the new regional laboratory located at Whittier, Calif., where he will have charge of the technical phases of the investigations carried on there, especially those having to do with the resistance to hydrocyanic acid gas of scale insects affecting citrus.

During the latter part of January a shipment of several hundred pupae of the European earwig parasite, *Digonochaeta setipennis* was received at the Belleville Ontario Parasite Laboratory from the Imperial Bureau of Entomology. It is intended to liberate the flies reared therefrom in British Columbia.

At the request of the War Department, Dr. T. E. Snyder, Bureau of Entomology, left Washington on March 29 to inspect with a representative of the Forest Products Laboratory, military supplies of wood at arsenals in Rock Island, Ill., New Cumberland, Pa., and Springfield, Mass. These inspections are made periodically, to prevent serious accumulative damage by powder post beetles.

The Connecticut Tree Protection Examining Board held an institute for the instruction of tree workers at the Hotel Garde, New Haven, on February 26. The following Entomologists took part in the program: Dr. W. E. Britton, New Haven, Chairman; Professor Glenn W. Herrick, Cornell University, Ithaca, New York; Dr. E. P. Felt, Stamford, Conn; Mr. M. P. Zappe, Dr. R. B. Friend, and Dr. Philip Garman, New Haven.

Mr. R. E. Balch, Entomological Branch, who was recently appointed to the position of Entomologist in charge of forest insect investigations in the Maritime Provinces and the Gaspe Peninsula, with headquarters at Fredericton, N. B., reported for duty at Ottawa, on Feb. 10. Mr. Balch was formerly Agent at the Coeur D'Alene Station of Forest Entomology, investigating forest defoliating insects of the northern Rocky mountain territory.

On April 17, D. W. Jones, Bureau of Entomology, in charge of the parasite work of the European Corn Borer investigations, met in New York a shipment of parasites of the citrus black fly (*Aleurocanthus woglumi* Ashby), collected by C. P. Clausen in the Straits Settlements. He then accompanied this shipment to Cuba, where he will act in an advisory capacity in the establishment of the parasites in that island.

R. C. Brown, of the Bureau of Entomology, Gypsy Moth Laboratory, sailed from New York City on March 12 to return to his temporary headquarters in Budapest, Hungary. Before reaching Budapest he will visit Sweden in search of information regarding parasites of a sawfly, *Phyllotoma nemorata* Fall., which has recently attracted considerable attention as a leaf-miner of birch in Maine, New Hampshire, Nova Scotia, and New Brunswick.

In the month of April the following appointments were made in the Bureau of Entomology, Chas. L. Barnes, Junior Entomologist, for duty at Tempe, Ariz., Virgil F. Kent, Junior Entomologist, at Monroe, Mich., Lewis H. Colby, Agent, at Toledo,

Ohio, Miss Marydea Thomas, Under Scientific Helper, at Tempe, Ariz., W. W. Baker, field assistant, Puyallup, Wash., R. N. Lux, field assistant, Walla Walla, Wash, and J. T. Ray, field assistant at Tallulah, La.

A valuable collection of Philippine Island insects, formed by Dr. W. Dwight Pierce while he was employed as entomologist for the Victorias Milling Company, of the island of Magnos, has through the interest of Dr. Pierce been received by the Bureau of Entomology from that company. It contains many rare insects, and interesting material of early stages, and will be a valuable addition to the collections of the national Museum.

The Dominion Entomologist of Canada, Mr. Arthur Gibson, attended the 17th annual meeting of the New Jersey Mosquito Extermination Association which was held at Atlantic City, N. J., Feb. 12–15. By special invitation he presented a paper at the evening session Feb. 13 on "Mosquito Investigations in Canada during 1929." In company with Dr. T. J. Headlee he visited the Japanese Beetle Laboratory to discuss with officials there certain co-operative work to be conducted in 1930.

In anticipation of funds specificially appropriated for investigations of peach insects in eastern Tennessee, which are expected to become available July 1, the Bureau of Entomology is establishing a field laboratory at Harriman, in that State. H. G. Butler has been put in charge of it, and has been transferred from the Bureau's laboratory at Wichita, Kans. Mr. Butler has been succeeded at Wichita by Edwin W. Howe, a graduate of the University of California, who reported for duty April 10.

E. R. Van Leeuwen, in charge of general insecticide investigations, Japanese Beetle Laboratory, returned to the Laboratory on March 16 from a furlough of three and one-half months. During his absence from the laboratory Mr. Van Leeuwen was in charge of the Department of Entomlogy at the Davey Institute of Tree Surgery, Kent, Ohio. A course in shade-tree insects was given to the freshman, and junior, and senior classes of the Institute by Mr. Van Leeuwen and his assistant, E. A. Sanford, of the Davey Tree Expert Company.

At a conference of the Council of the Northeastern Forestry Experiment Station held at Springfield, Mass., February 1, to discuss the need of research on forest insects, entomologists of the region were invited to attend and take part in the discussion. The following entomologists were present: Harold L. Bailey, Bradford, Vt., C. P. Alexander, K. A. Salman, H. J. MacAloney and H. L. Sweetman, Amherst, Mass., Mr. Nash, Augusta, Me., W. E. Britton and R. B. Friend, New Haven, Conn., H. L. McIntyre, Albany, N. Y., F. C. Craighead, Washington, D. C., A. F. Burgess and T. H. Jones, Melrose Highlands, Mass.

Preliminary to the organization of the Bureau of Entomology $100,000 Peach Moth work, a conference was held at Vincennes, Ind., April 4, when plans for the experiments were discussed. The attendence included S. C. Chandler, of the Illinois State Natural History Survey, Prof. J. J. Davis, of Purdue University, J. S. Houser, of the Ohio Agricultural Experiment Station, Prof. Leonard Haseman, of the University of Missouri, and Prof. W. A. Price, of the University of Kentucky, also Dr. F. H. Lathrop, Dr. B. A. Porter, R. F. Sazama, and W. P. Yetter, of the Bureau of Entomology, and several local fruit growers.

R. A. St. George, Bureau of Entomology, attended a meeting at the Forest Products Laboratory during the last week in April. This is a meeting held annually to

discuss the progress of forest research in the Forest Service and cooperating organizations. The Bureau of Entomology is chiefly interested in the development of plans for the economic survey provided for in recent legislation. An inventory of the forest resources of the country will be made, and an attempt to arrive at figures for depreciation due to insects and fungi will be part of the undertaking.

During the week of April 6 Dr. R. T. Cotton, of the Bureau of Entomology, was in Buffalo assisting in the fumigation of wheat with the ethylene oxide-carbon dioxide mixture. These fumigations were conducted under the direction of Laurel Duval, of the New York Produce Exchange. There were also present representatives of the Bureau of Chemistry and Soils and the Bureau of Agricultural Economics. During the week of April 21 Dr. Cotton and representatives of those Bureaus were present at Port McNicoll, Ontario, Canada, where over a million bushels of wheat were being fumigated with the ethylene oxide-carbon dioxide mixture.

On April 24 Perez Simons, W. D. Reed, and D. F. Barnes of the Bureau of Entomology visited Sacramento to attend the organization meeting of the entomologists and others interested in entomology in California north of the Tehachapi Mountains. About 65 were present. The name chosen for this organization, which is similar to the Entomological Club of Southern California, is the "California Entomological Club". Director Hecke delivered an address of welcome, and four papers were presented. The chief work of bringing about the organization has been done by Stewart Lockwood, formerly of the Bureau of Entomology, but now with the California State Department of Agriculture.

In view of the possible early removal of the smaller buildings connected with the Bureau of Entomology, and the resultant need of laboratory space elsewhere for workers who have been sheltered by them, the Bureau of Entomology Division of Deciduous Fruit Insects has leased quarters in Takoma Park, Md., at 7710 Blair Road. Accomodations at this address have also been provided for the scientific workers of the Division who have been quartered at Sligo, Md., and they are now transferring their equipment to the new laboratory. The workers who are moving from Washington include Dr. F. L. Campbell, H. H. Shepard, Charles Lukena, Miss Abby Holdridge, and Mrs. Bessie Bell.

The Deficiency Bill of the Bureau of Entomology carried $10,000 for experimental control of the spruce budworm in the Cody Canyon of the Shoshone National Forest. This is the east entrance to the Yellowstone National Park. A severe infestation of the spruce budworm has been progressing here for three or four years, and an attempt will be made to save the timber along the roadsides and around tourist camps by spraying with lead arsenate. From an investigational standpoint it is hoped that this work will demonstrate whether or not this insect, which feeds more or less concealed in the opening buds, can be controlled by arsenicals, and will determine the best time for application and the proper dosages.

Mr. Donald McCreary, a graduate of Iowa Wesleyan College and of the University of Maryland, has been appointed Research Fellow in the Department of Entomology of the University of Delaware, Agricultural Experiment Station, Newark, where he will conduct an investigation of oil sprays for control of the Oriental Peach Moth on peach and apple, sponsored by the California Spray Chemical Company thru the Crop-Protection Institute. Mr. L. L. Williams, Assistant Entomologist, continues in charge of the Entomological Laboratory at Camden, and Mr. William R. Haden,

a graduate of the University of Delaware, and Mr. Fred C. Daigh, a graduate of the University of Illinois, have accepted temporary appointments for the conduct of routine investigational work at Bridgeville and Newark respectively.

C. A. Bennett, Mechanical Engineer, of the Division of Agricultural Engineering, Bureau of Public Roads, who has heretofore been mentioned as cooperating with the field Laboratory at Tallulah in cotton-drying investigations, and having patented processes and methods devised there, was in Washington, D. C., from March 29 to April 18. Four patent claims, relating to his inventions, condensed into three public-service patents, have been granted, and a fifth claim appears to be on the way to recognition. While in Washington Mr. Bennett drafted four other claims for his division, and discussed matters pertaining to recent investigations in Mississippi.

H. S. Peters, detailed from the Division of Insects Affecting Man and Animals, left Washington April 14 for New York, where he took charge of the first consignment of *Microbracon kirkpatricki*, a parasite of the pink bollworm collected in Kenya Colony, Africa, and shipped through England to New York by the Imperial Bureau of Entomology. Mr. Peters carried the material in an iced container to El Paso, Tex., where it was delivered on April 17 to F. A. Fenton, in charge of research work on the pink bollworm. A second consignment of the parasites reached New York April 21 on the S. S. George Washington. J. L. Webb, of the Washington office, took charge of this shipment and arranged with the express company to forward it to Dr. Fenton at El Paso, the Company agreeing to keep the container supplied with ice en route. Dr. Fenton reports that the shipment was received in good condition.

Besides temporary field assistants, L. F. Steiner, D. W. Hamilton, and Francis Munger have been appointed for the experimental work on oriental fruit at Cornelia, Ga., and J: F. Cooper for that at Vincennes. W. P. Yetter has general charge of the experiments on control with bait traps, with headquarters for the present at Vincennes. The experiments at Cornelia will be under the immediate charge of Mr. Steiner, who is a graduate of Ohio State University and holds a Master's degree from that institution. For the past three years, as an employee of Purdue University, he has been in charge of investigations of the codling moth in south-central Indiana. Mr. Hamilton is a graduate of the University of Illinois and has done advanced work at that institution. Mr. Munger is a graduate of the University of Minnesota. Mr. Cooper is a recent graduate of the University of South Carolina, and for several years has been employed by the Bureau of Entomology on work with cotton insects.

As a result of efforts on the part of interested fruit growers, an appropriation of $100,000 was included by Congress in the First Deficiency Bill for additional work to be conducted by the Bureau of Entomology against the oriental fruit moth. Of this item $80,000 provides for large scale experiments with bait traps to be carried on in two different fruit sections, an area including 500 acres of peaches to be baited in each section. It is hoped that those experiments will answer the question which has long existed as to whether the use of bait traps over a wide area would give better results in the control of the oriental fruit moth than when a limited area of only a few acres is baited, in which case the surrounding unbaited area is in comparison very large. Irrespective of the results in terms of practical control, which of course can not be predicted at the present time, this investigation offers an opportunity to obtain much additional information about the oriental fruit moth. Mr. W. P. Yetter has been placed in charge of the bait work. In addition to the maintenance of bait

traps over large areas, important detailed experimental work is also contemplated. The localities selected for the work to be conducted during the season of 1930 are Cornelia, Ga., and Vincennes, Ind. The remaining $20,000 of this money is to be used to strengthen the work with parasites and insecticides and for a study of the ecology of the oriental fruit moth. The work with parasites and ecology is to be headquartered at Moorestown, N. J., under general supervision of Mr. L. B. Smith, and will constitute an enlargement of work already being conducted by Dr. H. W. Allen. The insecticide studies will be conducted at Vincennes, Ind., under the direction of Dr. F. H. Lathrop.

Apicultural Notes

On March 20 Jas. I. Hambleton, Bureau of Entomology, visited the vicinity of Westminster and New Windsor, Md., on an inspection trip for the location of an experimental apiary.

Dr. A. P. Sturtevant and J. E. Eckert, of the Bureau of Entomology Intermountain Bee Culture Field Station, Laramie, Wyo., have reported that the annual meeting of the Colorado Honey Producers' Association, held in Denver on March 4 and 5, which they attended was one of the best meetings ever held by the association. Both Dr. Sturtevant and Mr. Eckert appeared on the program and discussed various phases of the experimental work now under way at the Laramie Station.

On the afternoon of March 26 several members of the staff of the Bee Culture Laboratory attended a very interesting lecture by Dr. Karl von Frisch of the University of Munich, on the behavior of the honeybee. Doctor von Frisch's lecture, given in the auditorium of the Engineering Building at Johns Hopkins University was well illustrated with excellent lantern slides and marvelous motion-picture films, showing the behavior of the honeybee in its reactions to colors, odors, and taste. Even the evidence of "language" in the honeybee was clearly shown by the use of films.

Dr. Karl von Frisch, of the University of Munich, who has been in this country on a lecture tour, visited the Bee Culture Laboratory of the Bureau of Entomology on April 29 with Dr. N. E. McIndoo. Doctor van Frisch is an outstanding authority on the behavior of the honeybee, and is the author of numerous zoological papers. On Monday, April 28, he gave an interesting paper before the National Academy of Sciences on the sense of hearing in fishes. This lecture was well illustrated with a remarkable motion-picture film showing the response of fish to various sounds and exemplified graphically the advantage of using motion pictures to report the results of experiments in which the behavior of an organism is involved. On the evening of the same day a dinner, attended by a number of the members of the Bureau of Entomology, was tendered Doctor van Frisch at the Cosmos Club, after which before an appreciative audience, he gave a most interesting lecture on the language of the honeybee, illustrated by motion pictures. Doctor von Frisch sailed for Germany on May 2, after completing an extensive tour, during which he visited and lectured before a number of the principal eastern and mid-western universities. The following were among those he visited: Universities of Wisconsin, Minnesota, Indiana, Ohio State, Western Reserve, Buffalo, Yale, Harvard, and Johns Hopkins.

Horticultural Inspection Notes

Mr. B. R. Anderson was transferred from El Paso to Ysleta, Texas, on March 17, to take charge of the latter port.

Mr. W. R. Sudduth was transferred from El Paso to Fabens, Texas, on March 23, to take charge of the latter port.

Mr. L. A. Roberts was transferred from El Paso to Columbus, New Mexico, on April 22, to take charge of the latter port.

Mr. R. B. Lattimore was transferred from Brownsville, Texas, on March 20 to Presidio, Texas, to take charge of that port.

Port inspectors William J. Ehinger and Jose A. Ramos were transferred from El Paso, Texas, to Philadelphia, Pa., on February 1.

Dr. S. B. Fracker spent May 2 and 3 in New York City and on Long Island conferring with inspectors of the Administration concerning narcissus and transit inspection.

The States of Illinois, Iowa, and Wisconsin have recently amended their alfalfa quarantines to bring up to date the list of counties designated as infested with alfalfa weevil.

Eelworm infestations (*Tylenchus dipsaci*) have been recently found by inspectors and collaborators of the United States Department of Agriculture in narcissus in Alabama and Oregon.

Mr. N. A. Eaton, Junior Plant Quarantine Inspector who has been stationed at the port of Philadelphia for some time resigned on March 26, to accept a position with the State of Virginia.

Mr. C. P. Trotter is being transferred from the port of San Juan, P. R., to take charge of the plant quarantine work of the United States Department of Agriculture at the port of Sabine, Tex.

Mr. A. A. Stalmach was transferred from Brownsville, Texas, on March 24, to Rio Grande City, Texas, to take charge of the Plant Quarantine and Control Administration's activities at the latter port.

Mr. George J. Nicolaides was appointed a Junior Plant Quarantine Inspector at the port of New York, effective May 1, to fill the vacancy caused by the transfer of Mr. A. B. Wells to Philadelphia on the same date.

Mr. M. S. Mirimanian who has been employed for several years on the Pink Bollworm Project of the Plant Quarantine and Control Administration, was transferred to the Mexican Border service on April 1 and has been assigned to the port of Brownsville.

Mr. Clyde N. Partington, formerly employed in the Division of Forest Pathology, Bureau of Plant Industry, was transferred to the Port Inspection Service on May 9 and has been assigned to the port of Astoria, Oregon.

Mr. S. A. Rohwer spent most of April and the first half of May conferring with field employees of the Plant Quarantine and Control Administration in Texas, Arizona and California, and visited a number of other field stations of the Administration en route.

Mr. Ezekiel Rivnay who was employed as a Junior Plant Quarantine Inspector at the port of Philadelphia on October 12, 1929 was transferred to the Mediterranean Fruit Fly Project on February 10, 1930 and assigned to duty in Florida.

Mr. C. E. Baker, who has been engaged in white pine blister rust work for the Federal Bureau of Plant Industry and the Plant Quarantine and Control Administration for several years, resigned on February 28 to accept an appointment with the Conservation Department of New York.

The State of Pennsylvania has issued Quarantines No. 22 and No. 23 on account of Japanese Beetle and European corn borer, respectively, and established regulations thereunder in line with recent revisions of Federal regulations on account of infestations with these insects.

Mr. N. Rex Hunt, In Charge Import Division, left Washington on March 12 for the Pacific Coast to inspect special permit material being grown in the states of California, Oregon and Washington. Mr. A. G. Webb, in charge of the port work at Seattle, Washington, has been assisting Mr. Hunt in this work.

An informal conference was held in the office of the Plant Quarantine and Control Administration in Washington on April 10 to discuss various details connected with the enforcement of the Japanese beetle quarantine regulations. Representatives of all the States (except Pennsylvania) quarantined on account of this pest were in attendance.

The following members of the Japanese beetle staff who were temporarily assigned to assist in the enforcement of the Mediterranean fruit fly quarantine, have now returned to their former duties: J. R. Cassel, W. N. Dobbs, W. L. Gormley, H. C. Helliwell, J. W. Kelley, E. S. Russell, and W. J. Thomason.

Dr. John Gray, who has been on leave of absence from his position in the Entomology department of the University of Florida during the past year, resigned as Agent of the Plant Quarantine and Control Administration on May 1 to accept appointment in investigational work at Moorestown, N. J., under the Federal Bureau of Entomology.

The State of Tennessee has revoked the State quarantine on account of the chestnut blight which has been established since 1919 to prevent the movement of chestnut nursery stock from a number of eastern and southern states. This lifting of the former embargo is due to the presence of the chestnut blight in eastern and central Tennessee.

Louis A. Catoni, Chief Plant Quarantine Inspector of the Territorial Department of Agriculture and Labor, San Juan, P. R., reports that there are now on duty under his direction, in addition to an assistant and two port inspectors at San Juan, one inspector for each of the ports of Fajardo, Jobos, Arroyo, Ensenada, Arecibo, Mayaguez, Ponce and Aguadilla.

Mr. Richard Faxon, formerly Chief of the Bureau of Plant Industry of Ohio, and during the past two years a member of the Plant Quarantine and Control Administration staff at New York City, has been transferred to the port of San Juan, P. R., on a three-year assignment. He was accompanied on the trip to Porto Rico on May 15 by Mr. E. R. Sasscer, who is expected to return in about two weeks.

The State of Texas requires that citrus seed originating in the State of Florida which is to be shipped into Texas must be dipped in a 1–1000 corrosive sublimate solution and then shipped direct to the Texas Department of Agriculture, where it is refumigated with hydrocyanic acid gas. This restriction is reported to have been placed on citrus seed shipments "to eliminate any possible chance of any insects being carried into the main citrus belt of Texas."

Extensive orchard inspections have been carried out by the Texas State Department of Agriculture during the past year, especially for the purpose of determining whether there is any possibility of the Mediterranean fruit fly having arrived in the State. The groves were also inspected at the same time for the Oriental peach moth and the phony peach disease. No infestations or infections of either of the insects or the disease named were discovered in the State.

Dr. R. W. Leiby, State Entomologist, Raleigh, N. C., has been appointed Secretary of the National Plant Board to hold office until the next regular meeting of the Board. Doctor Leiby succeeds Dr. W. A. McCubbin, who resigned as Secretary of the National Plant Board when he was appointed by the Plant Quarantine and Control Administration to take charge of the certification of Florida products for intrastate and interstate movement under the Federal and State quarantines on account of the Mediterranean fruit fly.

Effective March 18, 1930, the State Department of Agriculture of California revised the State ozonium root rot quarantine (No. 13) to add Arkansas to the States quarantined and to modify the certification and permit requirements formerly in effect. All nursery stock, trees, plants, shrubs and vines (not including such materials free from soil) from the States of Arizona, Arkansas, Texas, Oklahoma and New Mexico, must be certified as grown on premises free from the rot.

The following who have been engaged during the past few months in car-cleaning and cold sterilization supervision, transit inspection, or phony peach disease activities, for the Plant Quarantine and Control Administration, were transferred to the Bureau of Plant Industry for the summer: F. J. Baker, W. E. Bradder, C. M. Chapman, W. J. Cullen, L. M. Culpepper, E. J. Ethridge, N. H. Harpp, L. W. Hodgkins, A. J. Lambert, C. O. Peterson, F. H. Rose, R. E. Wheeler, and G. M. Whiting.

On April 10, 1930, the Plant Quarantine and Control Administration issued a "List of True Bulbs, Corms and Tubers" as PQCA-274. The list was issued for the information of shippers within the areas regulated under the provisions of the Japanese beetle quarantine. The latest revision of the regulations supplemental to that quarantine exempts such true bulbs, corms and tubers from the requirement of certification when they are shipped without fibrous roots and are free from soil, except that this exemption does not apply to dahlias.

The Domestic Quarantine division of the Plant Quarantine and Control Administration has established regional offices for the administration of transit inspection and the enforcement of the blister rust and phony peach disease quarantines at 1511 Manhattan Building (431 So. Dearborn St.) Chicago; 641 Washington St., New York City; 332 State Capitol, Atlanta, Ga.; and 406 Federal Building, Spokane, Washington. Mr. J. M. Corliss is in charge at Chicago, Mr. C. B. Beamer at New York, Mr. G. W. R. Davidson at Atlanta, and Mr. C. R. Stillinger at Spokane.

"A Summary of State and Territorial Plant Quarantines Affecting Interstate shipments," has been prepared by Miss M. A. Thompson of the Plant Quarantine and Control Administration, and is now in proof. It is expected to be available for distribution as Miscellaneous Circular No. 80 during June or July. It is being prepared in loose leaf form and is expected to be kept up-to-date by the issuance of revised sheets to those who secure copies of the complete summary. The synopses of the regulations have been approved by the plant quarantine officers of the States concerned.

A public hearing was held in the office of the Plant Quarantine and Control Administration, 1729 New York Avenue, N. W., Washington, D. C., on April 24, 1930, for the purpose of considering the advisability of extending the phony peach disease quarantine to the State of Mississippi. At this hearing the State of Georgia was represented by Mr. M. S. Yeomans, State Entomologist, and the State of Mississippi by H. H. Kimball, Chief Inspector, State Plant Board of that State. The hearing was also attended by a number of representatives of the Federal Department of Agriculture. No action has yet been taken as a result of this hearing.

Three terminal inspection points for nursery stock and other plant materials are now being maintained by the State Department of Agriculture of Wyoming. The inspection at Casper is carried on by Mr. Krueger; that at Laramie by Mr. Crawford and that at Sheridan by Mr. Stocker. During the past year 1756 shipments were received at these points, of which four were returned to the shipper, five destroyed on account of infection or infestation, and one taken in violation of the Federal white pine blister rust quarantine. Mr. A. G. Stephens, Cheyenne, Wyo., is in charge of quarantine enforcement and nursery inspection activities. Forty-four nurseries are licensed in the State.

The Texas State Department of Agriculture on May 5 issued quarantine proclamations numbered, 29, 30, 31, 32, 33, 34, 35 and 37, prohibiting the entry from Florida of various kinds of citrus nursery stock and other fruit and ornamental trees and shrubs, on account of scaly bark, citrus canker, white fly and a number of other designated insect pests and plant diseases. It is stated that one of the reasons for issuing these new proclamations is that "the validity of State Proclamations 18, 19, 20 and 21, designed to regulate the movement of citrus fruit and nursery stock have been questioned because they were not re-proclaimed by the Commissioner of Agriculture under Chapter 15, Acts of the Second Called Session of the 41st Legislature."

An informal conference to consider the potato wart situation, with particular reference to Pennsylvania, Maryland and West Virginia, was held in the office of the Plant Quarantine and Control Administration at Washington on April 12. Those present included Professors C. E. Temple and R. A. Jehle of Maryland; Dr. T. L. Guyton of Pennsylvania; Professor W. E. Rumsey of West Virginia; Drs. K. F. Kellerman and Freeman Weiss of the Bureau of Plant Industry, and Drs. W. A. McCubbin and S. B. Fracker of the Administration. A decision was reached to continue the present State quarantine and suppression policies for the coming year and to consider the subject further either early in the spring of 1931 or in the fall of 1930.

The California sweet potato weevil quarantine (No. 9) was revised by the State Department of Agriculture of that State, effective March 12, 1930, to withdraw from the area designated as infested, the counties in Oklahoma which had previously been included within such area. The present order prohibits the entry of sweet

potato tubers, plants and cuttings, morning-glories and yams, from the following described territory for any purpose; the States of Florida, Texas, and Louisiana; the Counties of Jackson, George, Hancock, Harrison and Pearl River, in Mississippi; the Counties of Baldwin, Jefferson and Mobile in Alabama; and Charlton County, Georgia. Special certification is required for above materials (except morning-glories) when shipped from points outside the infested areas.

Recent orders issued by the Plant Quarantine and Control Administration with respect to the transportation of Florida host fruits and vegetables are as follows: PQCA-272—"Modification of Production, Harvesting and Shipment Restrictions on Florida Host Fruits and Vegetables"; PQCA-273—"Spraying Requirements for Grapes Produced in the Eradication Area of Florida"; PQCA-275—"Reshipment of Certain Florida Host Fruits and Vegetables Within Southern and Western States Authorized"; PQCA-276—"Elimination of Summer Host Plants in Eradication Area of Florida Will not be Required"; PQCA-279—"Re Disposition of Ripening Citrus Fruits, Avocados, Persimmons, Host Vegetables and Bananas in the Eradication Area of Florida During the Host Free Period"; PQCA-280—"Shipment of Florida Peppers and Lima and Broad Beans to Central States, and Reshipment of Host Vegetables Within Northern and Central States Authorized."

PQCA-277, issued by the Plant Quarantine and Control Administration on April 22, 1930, authorizes the importation under permit until further notice subject to treatment under the supervision of representatives of the Administration, in quantities not to exceed 100,000 to each permittee, of the following varieties of narcissi, namely: Spring Glory, Glory of Sassenheim, Victoria, Emperor and Golden Spur. The notice states that it appears from evidence before the Administration that the present supply for planting purposes of these varieties has been considerably reduced with the result that planting stock is apparently not obtainable in sufficient quantities to meet present propagating needs. It was further ordered that since the need for further importation of the propagating stock of Gloriosa, Minister Talma, Pheasant's Eye and Tresserve still exists, these varieties may continue to be imported within the 25,000 quantity limit which applies to varieties other than those first named.

Mr. Lee A. Strong, Chief of the Plant Quarantine and Control Administration, has issued, effective July 1, 1930, a list of representative genera of plants subject to importation under special permits, with the maximum yearly quantity limit given for each genera. In connection with this order, Mr. Strong stated that "ten years have elapsed since this quarantine became effective and it is now believed that the horticultural interests of this country have had ample opportunity to build up stocks of standard varieties of plants and adjust their operations to the new conditions which followed the promulgation of the quarantine in 1919. It appears that this period of readjustment has largely passed, since most growers have recently confined their requests for special permit stock to small quantities of new species and varieties or novelties. It is evident, therefore, that there is no necessity for the continued assumption of needless pest risk through further importations of these restricted plants in such large numbers as has heretofore been permitted."

The Agricultural Appropriation Bill for the Department of Agriculture as passed by the House of Representatives includes for the work of the Plant Quarantine and Control Administration, the following items: $73,000 for general administrative purposes; $720,000, in addition to an unexpended balance of $10,000, for the en-

forcement of foreign plant quarantines; $40,000 for transit inspection; $497,000 for the control and prevention of spread of the pink bollworm; $65,000 for the control and prevention of spread of the Parlatoria date scale; $34,300 for the control and prevention of spread of the Thurberia weevil; $647,500 for the control and prevention of spread of the gipsy moth and brown-tail moth; $1,000,000 for the control and prevention of spread of the European corn borer; $475,000 for the control and prevention of spread of the Japanese and Asiatic beetles; $10,000 for the control and prevention of spread of the white pine blister rust; $12,000 for the control and prevention of spread of the phony peach disease; $115,000 for the control and prevention of spread of the Mexican fruit worm; $20,000, in addition to an unexpended balance of $10,000, for export certification; a total of $3,708,800. The Senate added as an amendment an item of $6,900,000 for Mediterranean fruit fly work. At the time of writing (May 13) the bill is in conference committee.

Mr. J. S. Woodard, Chief of the Nursery and Pecan Division of the State Department of Agriculture of Texas, reports that the division under his direction is organized as follows for the season 1930: There are seven regular nursery inspectors, namely, J. C. Stephens, Tyler, Tex.; R. F. Campbell, Alvin, Tex.; W. J. Abbey, San Antonio, Tex,; R. T. Milner, Dallas, Tex.; E. A. Schattenberg, Harlingen, Tex.; C. D. McGehee, Lubbock, Tex., and Walter T. McKay, Austin, Tex., in addition to W. W. Kirkpatrick, San Saba, Tex., who devotes a part of his time to nursery inspection. For the inspection of pecan nurseries, both for insects and as to trueness of variety name, two inspectors are employed, namely, Frank J. Willmann and L. D. Romberg, of Austin, Tex. The inspection of citrus nurseries is carried out largely by the citrus canker inspectors who are: E. W. Halstead, Mission, Tex.; Hal F. Halstead, Mission, Tex.; J. K. Thompson, Edinburg, Tex.; W. P. Daniel, Donna, Tex.; G. F. Wilson, Brownsville, Tex.; B. F. Bryant, Palacios, Tex.; and J. L. Summers, Laredo, Tex. There are now 1726 nurseries and greenhouses in Texas to inspect, with something like 500 sweet potato inspections in addition to the nursery work. Narcissus bulbs are grown on ten different premises, all of which were granted certificates showing freedom from infestation, except that one variety on the premises of one company was required as a condition of certification to be given the hot water treatment because of the presence of an infestation of *Aphelenchus subtenuis*.

Notes on Medical Entomology

Merwin Monagin has been appointed Field Assistant, Bureau of Entomology, dating from March 8, and assigned to the field laboratory at Uvalde, Tex.

T. E. McNeel, of the Bureau of Entomology field laboratory at Mound, La., has returned to Zellwood, Fla., to continue the study of mosquitoes of the genus Mansonia, which he began last year.

On April 2, F. C. Bishopp, Bureau of Entomology went to Baltimore to confer with Dr. Baer, of Johns Hopkins University in regard to the rearing of blow-fly larvae, which Dr. Baer is using for treatment of certain bone diseases.

H. E. Parish, formerly on the staff of the Mississippi State Plant Board, has been appointed Assistant Entomologist, Bureau of Entomology, and assigned to the field laboratory at Menard, Tex. He reported there for duty March 27, and will relieve E. C. Cushing, who will soon go to Alaska to continue the investigations of reindeer insects begun by W. E. Dove in 1929.